
**FACTORS ASSOCIATED WITH HEARING AID
DISUSE IN
NEW ZEALAND/AOTEAROA**

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Abstract

Introduction: Despite the advantages of using a hearing aid (HA), only 1 out of 5 individuals who could benefit from a (HA) actually use one (World Health Organization, 2012). If an individual does not use a HA then it may impact on their quality of life, as well as others around them (Chia et al., 2007). Therefore it is important to understand why individuals do not use HAs after obtaining them. To date, there has been no study that investigates the reasons for HA disuse in the New Zealand population.

Methods: Two groups of adults with hearing impairment were recruited: HA users (N = 35) and HA disusers (N = 35). Six self-report questionnaires, three audiometric tests and two other body function measures were compared between the groups.

Results: Several variables differentiated HA users from disusers, these significant variables were: cognition, understanding speech in noise, acceptance of noise, age at testing, education, hearing assistance technology (HAT) use, HA satisfaction, self-efficacy, accepted need, application for HA subsidy, HA outcomes, stages-of-change, perceived environmental influence, follow-up support and hearing related activity limitations/participation restrictions (AL/PR).

Discussion: The clinical value of identifying factors related to HA disuse is so clinicians can identify “red flags” for disuse before the client stops using their HAs. By identifying these red flags, rehabilitation can be tailored around the clients’ needs; before the negative consequences of an untreated hearing impairment is felt.

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Chapter One: Introduction

1.1 Overview

Hearing impairment is one of the most prevalent chronic conditions worldwide (Danermark et al., 2010; Solheim, Kværner, Sandvik & Falkenberg, 2012). In 2005, the World Health Organization (WHO) reported that approximately 642 million people worldwide were living with hearing impairment. In New Zealand, it has been estimated that somewhere between 10% (Greville, 2005) to 17% of the population are living with a hearing impairment (“National Foundation for the Deaf,” n.d). Increased human longevity has seen a rise in the number of elderly individuals suffering from age related hearing impairment (presbycusis). Additionally, about 1 in 4 babies with a birth weight below 1.5 kg have central or peripheral hearing impairment, or both (Jiang, Brosi & Wilkinson, 2001). Therefore, an increased survival rate of premature or at risk infants is also thought to have influenced the increase in prevalence of hearing impairment.

Hearing impairment can significantly reduce an individual’s ability to receive and understand speech signals. Thus, the consequences of a hearing impairment may manifest in a broad spectrum of an individual’s life. Everyday communication may be difficult and for some individuals, impossible. An individual may feel the ramifications of a hearing impairment at home, in the workplace and in the community. As a result, interpersonal relationships can become negatively affected (Slawinski, Hartel, & Kline, 1993). It has also been firmly established that hearing impairment can negatively impact on an individual’s quality of life (Chia et al., 2007;

Heine & Browning, 2004) and may lead to mood disorders such as anxiety and depression (Kvam, Loeb & Tambs, 2007).

The primary clinical intervention for individuals with hearing impairment is HAs. Although not all individuals with a measurable form of hearing impairment are candidates for HAs (Kochkin, 2009). For those individuals who are candidates, the average age of their first HA fitting is 74 years old, with many suffering for an average of 10 years before seeking audiological services. Using HAs is thought to improve quality of life issues, specifically by improving communication with family and friends; emotional stability; intimacy and warmth in relationships; perception of physical health and mental functioning and sense of control over life events (Kochkin, 2012).

Despite the advantages of using HAs, only 1 out of 5 individuals who could benefit from a HA actually use one (World Health Organization, 2006). Therefore a major challenge of audiological rehabilitation has been to encourage those who have HAs to continually use them. Chien and Lin (2012) estimate that nearly 23 million adults in the United States with a hearing impairment do not use HAs. An individual's quality of life, as well as others around them, maybe negatively impacted if HAs are not utilized. Therefore it is important to understand why individuals fail to use their HAs.

Numerous studies have examined HA use. However, there is a lack of consistency and robustness in the way that HA use and HA disuse have been defined. What is more, a majority of literature on the reasons for HA disuse was published

before the introduction of digital HAs. Considering that digital HAs were designed to offer clinical and practical advantages over analogue HAs it may be reasonable to expect changes in reasons for HA disuse. To date, there has been no study that investigates the reasons for HA disuse in the New Zealand population. Therefore this study aims to identify factors that are related to HA disuse.

1.2 Hearing Impairment

1.2.1 Overview

A hearing impairment is defined as abnormal or reduced hearing sensitivity to the frequency and intensity of sound (Bagai, Thavendiranathan, & Detsky, 2006). Decreased sensitivity to auditory stimuli is a result of abnormalities in the structure and/or function of the auditory system. Abnormalities within the auditory system can differ in the nature, aetiology, location, onset, duration and severity (Gelfand, 2009). An individual's hearing impairment is classified in terms of type, severity and configuration; these components are determined using a routine audiologic test battery. Pure-tone audiometry is undertaken to establish the lowest level (threshold), in dB HL, at which an individual detects a pure tone stimulus 50% of the time. Testing typically occurs at octave frequencies between 500 and 8000 Hz. The current standard for determining this threshold is called the Hughson-Westlake technique (1944), as modified by Carhart and Jerger (1959), which presents pure-tone stimuli in a descending/ascending pattern of 10/5 dB HL respectively. The type, severity and configuration of the hearing impairment can then be inferred from the pure tone audiogram.

The type of hearing impairment refers to the general site of lesion. If the impairment occurs at the outer or middle ear, the hearing impairment is referred to as conductive. Abnormalities in the auditory system that may cause a conductive hearing impairment include aural atresia, impacted cerumen, tympanic membrane perforations, otitis media with effusion, otosclerosis, ossicular discontinuity, glomus tumours and cholesteatomas of the middle ear space. Conductive hearing impairments are not always permanent and can often be treated by medical or surgical means.

Hearing impairment as a result of cochlear and/or nerve damage is called sensorineural hearing impairment and is typically permanent. Some abnormalities that may occur within the cochlea include noise induced hearing impairment, presbycusis and endolymphatic hydrops. Abnormalities that have a neural (retrocochlear) origin include Vestibular Schwannoma, Bell's Palsy, neuropathy of the auditory nerve, or lesions of the central auditory pathway. A hearing impairment can be mixed in nature, when both conductive and sensorineural components are evident.

The terms normal, slight, mild, moderate, moderately-severe, severe and profound are commonly used to describe the severity of an individual's hearing impairment (Clark, 1981). The severity of a hearing impairment can be classified by taking into account the audiometric thresholds at the tested frequencies. Alternatively, a pure-tone average (PTA) of thresholds at 3 frequencies (3-PTA; 500, 1000 and 2000 Hz) can be used to classify the severity of a hearing impairment. A common way to classify the severity of a hearing impairment is: frequencies at 20 decibels hearing level (dB HL) or below is considered normal hearing; thresholds from 21-40 dB HL are referred to as mild; thresholds between 41-55 dB HL suggests a moderate hearing

impairment; thresholds between 56-70 dB HL are referred to as a moderately-severe hearing impairment; thresholds between 71-90 are considered severe, and thresholds above 90 dB HL are considered a profound hearing impairment (Goodman, 1965; Jerger & Jerger, 1980). The configuration refers to the shape of the audiogram. Configuration is usually classified as: flat, gradually falling, sharply falling, precipitously falling, rising peaked or saucer, trough, notched (Cahart, 1945; Lloyd & Kaplan, 1978).

1.2.2 Prevalence

Reported prevalence of hearing impairment varies in the literature, with the exact percentages and numbers varying to some extent. The prevalence of hearing impairment can be determined by objective measures or by subjective reports. Audiometric testing is an objective measure of hearing impairment and tends to reveal a greater prevalence than subjective measures, such as self-reported hearing impairment. This is one of the major factors influencing the estimated prevalence of hearing impairment. Prevalence also varies with the definition of hearing impairment, age and location.

1.2.2.1 Definition of hearing impairment

Degree of hearing impairment is reported differently in the literature. Some reported estimates include unilateral hearing impairments, whereas others do not. Prevalence can also double when a mild hearing impairment is included in the percentage. World Health Organization (WHO) estimates that 278 million individuals have a disabling hearing impairment of a moderate classification or greater (> 40 dB HL). However, if mild hearing losses (26 - 40 dB HL) are included, this estimate rises

to 642 million people, which is just over 10% of the world population at the time (World Health Organization, 2006). Furthermore, the classification system used to denote degree of hearing impairment also impacts on the prevalence. As a result, studies that use the Northern and Downs classification system (normal hearing is ≤ 15 dB HL) to define hearing impairment would result in a larger prevalence estimate than if using Goodman's system (normal hearing is ≤ 25 dB HL) (Goodman, 1965). The global prevalence estimate of 642 million people living with a hearing impairment, classifies the normal limits of hearing as ≤ 25 dB HL (World Health Organization, 2006).

Some estimates of prevalence report hearing impairment only for high frequency hearing losses, if the mean pure-tone audiometric thresholds are > 25 dB HL at 3, 4 and 6 kHz. Other estimates are based on speech frequency hearing loss, which is indicated if the mean pure-tone audiometric thresholds are > 25 dB HL at 0.5, 1, 2, and 4 kHz. Speech frequency hearing loss is reported less frequently than high frequency hearing losses due to the effects of age-related hearing impairment. Age-related hearing impairment typically starts as a high frequency hearing loss and then progresses to lower frequencies over time (Schuknecht, 1974).

In New Zealand, it is estimated that there are approximately 700,000 individuals, living with some degree of hearing impairment. This is approximately 17% of the population which is similar to reports found in the United Kingdom with estimates of 16% of individuals aged 17 - 80 (with a bilateral hearing impairment of more than 25 dB HL at 0.5, 1, 2 and 4 kHz) (Davis, 1989) and in the United States with estimates of 16% of individuals aged 20 - 69 (Agrawal, Platz & Niparko, 2008).

If unilateral losses were included in the United Kingdom data set, this number would rise to 25%. These numbers may rise to as high as 46% for those over 65 years of age (Cruickshanks et al., 1998). Despite all of this, self-report of hearing impairment is much lower. In New Zealand, only 9.8% (368, 600) of the population, reported a hearing impairment in the 1991/1992 New Zealand Census, this number rose to 10.3% when estimates included institutionalized individuals (Greville, 2005). Similar results were found in the United States in 2008 with the Marke-Trak self-report survey, with only 11.3% of individuals reporting that they have a hearing impairment (Kochkin, 2009).

1.2.2.2 Hearing impairment and age

It has been well established that the prevalence of acquired hearing impairment increases with age. According to the New Zealand Census, hearing impairment is approximately 3.5 times more prevalent in individuals aged > 65 years than amongst adults < 65 years (Greville, 2005). Agrawal et al. (2008) conducted a study in the United States with 5742 individuals. A hearing impairment was defined as mean pure-tone thresholds, ≥ 25 dB HL at 3, 4, and 6 kHz. It was found that 8.5% of individual's aged 20 - 29 had high frequency hearing impairment. This increased to 17% of 30 - 39 year olds, 34% of 40 - 49 year olds, 53% of 50 - 59 year olds and 77% of 60 - 69 year olds (Agrawal et al., 2008).

1.2.2.3 Location of population

The prevalence of hearing impairment within a population varies as a result of geographical location, urban regions, rural regions and living environment. Location impacts prevalence as comparisons can be made broadly between “developed”

countries and “developing” countries or within a population, such as comparisons made for those over the age of 65 who live in the community vs. those that live in nursing homes. A higher prevalence of hearing impairment globally has been reported in lower income, geographical regions such as South-East Asia, with a lower prevalence of hearing impairment reported in high-income regions (Stevens et al., 2013). Furthermore, for individuals over 65, a higher prevalence of hearing impairment is consistently reported for those who live in nursing homes, compared to those who live in the community.

1.2.2.4 Division by sex

It has also been consistently reported that the prevalence of hearing impairment is higher among males than females (Agrawal et al., 2008; Gates, Murphy, Rees, & Fraher, 2003; Greville, 2005). Globally, as of 2008, the estimated average hearing impairment for males over the age of 15 was 12.2% compared to 9.8% for females over the age of 15 (Stevens et al., 2013). Even after controlling for occupational exposure, males continue to have a higher prevalence of hearing impairment.

1.2.3 Impact of hearing impairment

Everyone experiences the consequences of hearing impairment differently. Irrespective of age, hearing impairment has consequences for interpersonal communication, quality of life, psychosocial well-being and economic independence (Kotby, Tawfik, Aziz & Taha, 2008; Mason & Mason, 2007; Shield, 2006). Children born with a hearing impairment may have delayed speech and language development, which may set the child behind in educational and vocational attainment (Karchmer &

Allen, 1999; Schroeder et al., 2006; Venail, Vieu, Artieres, Mondain, & Uziel, 2010). In adults, hearing impairment can lead to social isolation, loneliness, embarrassment, stigmatization, prejudice, depression, difficulties with relationships, restricted career choices, occupational stress and lower earnings (Mohr et al., 2000; Ruben, 2000; Shield, 2006).

As previously mentioned, hearing impairment is usually described by methods such as pure-tone audiometry. While audiometric data are appropriate for measuring specific functions, audiometry appears to be limited in predicting the consequences that a hearing impairment can have on an individual's daily activities and involvement in life situations (Sataloff, Sataloff, Virag, Sokolow & Luckhurst, 2006). This can be illustrated by the generally fair-to-moderate correlations between audiometric measures and disability-based questionnaires (Chang, Ho & Chou, 2009). A limitation of disability-based questionnaires is that there are a large number of instruments available with little consensus on which one to use (Granberg, Dahlström, Möller, Kähäri & Danermark, 2014). The World Health Organization provides a valuable framework called the International Classification of Functioning, Disability, and Health (WHO-ICF) (World Health Organization, 2001) to evaluate how a hearing impairment can affect an individual holistically.

1.2.3.1 Impact of health conditions

This study has focused on factors associated with HA disuse in adults. Children were not included in this study, as parents tend to determine whether or not a child uses their HAs. Therefore, the remaining literature review will focus on adults beginning with the International Classification of Functioning, Disability, and Health

(ICF) model for adults. The ICF is a framework providing a common language for describing health and health-related states and has become a universally accepted framework across multiple medical disciplines. It merges a social paradigm with a biomedical paradigm so that a wider understanding of human functioning can be achieved. The ICF involves the components of human functioning rather than just the consequences of a disease or condition. The model was initially the International Classification of Impairments, Disabilities, and Handicaps (World Health Organization, 1980), which has since been updated (International Classification of Functioning, Disability and Health; World Health Organization, 2001). In this newest addition, an individual's functioning is described in terms of the person's body (Body functions and Body structure component) and in terms of the activities the individual executes and the situations the individual is involved in (Activities and Participation component) (World Health Organization, 2001).

‘Body structures’ are the anatomical parts of the body and ‘Body functions’ are the physiological functions of body systems. ‘Activities’ refer to the execution of a task or an action by an individual and ‘Participation’ refers to the involvement in life situations. Functioning is the umbrella term used for all body functions, activities and participation. Disability is the umbrella used for all impairments, activity limitations (AL) and participation restrictions (PR). The ICF states that an individual's functioning can also be influenced by contextual factors (personal and environmental factors). Personal factors relate to the intrinsic part of an individual, not related to the health condition such as the individual's gender, education or age. Environmental factors make up the attitudinal, social and physical environment in

which an individual lives and carries out their life. Figure 1 shows how these components interact with one another.

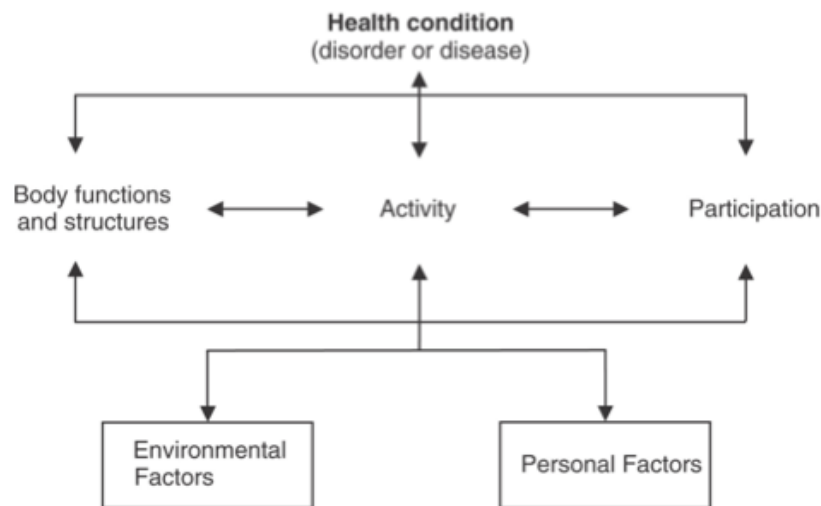


Figure 1. ICF Model (World Health Organization, 2001)

1.2.3.2 Measurement of the impact of health conditions

As discussed earlier, pure-tone audiometry can describe the level of the hearing impairment but it is unable to provide information about how individuals experience their hearing impairment in everyday life. Two individuals may have the same degree of hearing impairment but each person may experience their hearing impairment differently as a result of different personal and environmental factors (Chang et al., 2009; Chew & Yeak, 2010). Thus, the hearing related AL/PR experienced by an individual does not necessarily correspond to that individual's measured hearing impairment (Demorest, Wark & Erdman, 2011). Therefore, taking a holistic approach to intervention can help clinicians grasp an idea on how an individual is dealing with their hearing impairment. This can be achieved through self-reports of hearing impairment (Demorest et al., 2011). Self-assessment questionnaires are an invaluable part of the audiological tool-kit and these measures

are available for general, health-related quality of life and more specifically hearing impaired quality of life. It has been reported that those individuals identified by their significant level of hearing related AL/PR may be the ones who benefit most from HAs or other interventions (Chang et al., 2009; Chew & Yeak, 2010). Questionnaires such as the Hearing Handicap Questionnaire (HHQ) (HHQ; Gatehouse & Noble, 2004) are useful means of addressing health-related disease-specific quality of life.

1.2.3.3 Effects of hearing impairment on quality of life

It has been well established that a hearing impairment is associated with a reduced quality of life among individuals (Chia et al., 2007). Poor health related quality of life (HR-QoL) is thought to affect psychological, social and emotional functioning (Nachtegaal et al., 2009).

Some studies in the literature have found that reduced HR-QoL and wellbeing are related to an individual's severity of hearing impairment (Dalton et al., 2003; Helvick, Jacobson & Hallberg, 2006a; Hickson et al., 2008). However, other studies have failed to find a significant relationship between HR-QoL and severity of hearing impairment (Hallberg, Hallberg & Kramer 2008; Helvick et al., 2006a; Hickson et al., 2008).

Other factors related to a reduced HR-QoL and wellbeing are: self-reported communication difficulties (Hallberg et al., 2008); hearing related AL/PR (Dalton et al., 2003); sense of humour (Helvick et al., 2006a); and use of maladaptive behaviours such as withdrawal from social situations (Hallberg et al., 2008). Duration of hearing

impairment and subjective report of hearing impairment are reportedly not associated with HR-QoL (Helvick et al., 2006a).

As difficulties in communication arise as a result of hearing impairment, marital strain between partners and tension among family members can occur at home. This can negatively affect individual's HR-QoL (Kelly & Atcherson, 2011; Sataloff et al., 2006). Not only do individuals with hearing impairment have difficulties at home, they also experience difficulties in the workplace and social settings. Sataloff et al. (2006) reported that individuals with hearing impairment experience economic hardship either directly through job performance or indirectly through reduced social contact in the work environment. Furthermore, difficulties communicating in the workplace and in social settings, whether quiet or noisy, can be stressful for an individual with a hearing impairment (Jennings & Shaw, 2008; Hickson et al., 2008).

It has also been reported that the effects of hearing impairment decrease as age increases. Tambs (2004) reported that with increasing age, hearing impairment is seen as more common and viewed as less troublesome. Several studies have also found a relationship between hearing impairment and impaired activities of daily living with increasing age (Dalton et al., 2003; Gopinath et al., 2012).

Overall, the literature reports a diverse range of results for the effects of hearing impairment on HR-QoL. Discrepancies may stem from studies employing different means of quantifying hearing impairment and different ways of measuring HR-QoL.

1.2.4 Effect of intervention on hearing impairment

Due to the high prevalence of hearing impairment and the well-known negative impacts on HR-QoL, a lot of energy has gone into developing interventions aimed at reducing the negative impacts of hearing impairment. Devices range from cochlear implants, HAs and hearing assistance technology (HAT). Aural rehabilitation is another form of intervention aimed at minimizing and reducing difficulties associated with hearing impairment through the means of communication strategies, auditory training and speech-reading training (Tye-Murray, 2009). There is evidence for the effectiveness of aural rehabilitation, however outcomes are influenced by numerous personal factors including: readiness, motivation, sense of entitlement, expectations, personality, perceived locus of control, lifestyle, adaptability, cognitive function, perception, tactile, visual perception, resources and support from significant others (Boothroyd, 2007).

HAT refers to any device that facilitates access to auditory information (Tye-Murray, 2009). The assistance provided by this device can be in the form of an assistive listening device (ALD), devices that facilitate reception of auditory information or by means other than amplification such as visual displays or vibrotactile stimulation. ALDs are typically used in specific situations, such as when listening in a restaurant or a public hall. ALDs are particularly useful when listening conditions are less than ideal, particularly when the audio signal is presented at a distance. In these situations, ALDs can perform better than HAs and cochlear implants by improving the signal-to-noise ratio when there is ambient noise, reverberation and background noise (Tye-Murray, 2009). ALDs include: FM systems,

telephone amplifiers and devices for the television, radio or music. Assistance provided by visual displays includes: television captions, flashing telephones, doorbells and smoke alarms. Alternatively, vibratory signals can alert an individual with a hearing impairment to signals. One example is a vibrating alarm clock, where the vibrator is placed under the individual's pillow.

1.2.4.1 Hearing aids

A HA is a device that provides amplification of sound to the wearer (Tye-Murray, 2009). The HA consists of a microphone, pre-amplifier, amplifier volume control, level receiver and battery. The microphone picks up acoustic signals from the ambient environment. This acoustic signal is converted into an electrical signal, which is then passed to the amplifier. The signal is selectively amplified based on the individual's audiogram. From the amplifier, the processed electrical signal is sent to the receiver where it is then converted back into an acoustic signal and sent into the ear. When fitting a HA, an important step is to verify the HA using real-ear measures. The insertion gain of the HA is the difference between the unaided and aided response and is compared with prescription targets. Commonly, there is a mismatch between the manufacturer's predicted insertion gain for a HA and the measured real-ear insertion gain. Therefore, the frequency response of the aid can be adjusted to closely match the prescription targets. Typically, this involves adjusting the gain and/or compression in each frequency band (Bentler & Mueller, 2009). Matching targets is important as Hickson, Meyer, Lovelock, Lampert, and Khan (2014) found that individuals were more likely to have successful HA outcomes if the insertion gain better matched the targets for the 55 dB curve in the worse ear.

Modern HAs use Digital Signal Processing (DSP) to process acoustic signals. The foundation of a DSP HA is a numeric processor that works with numbers rather than analog signals. A DSP HA converts acoustic inputs to numbers, or data. Once the data is processed through the DSP circuit, it is reconverted to an acoustic signal and delivered to the ear. In most DSP HAs, the frequency spectrum of the signal is divided into a series of bands, and the signals in each band are then treated relatively independently (Frye, 2002).

Apart from amplifying sound, the HA uses compression, (more commonly, wide dynamic range compression (WDRC)) to ensure that amplified sounds are within the user's dynamic range. The dynamic range is the range of audibility from the softest sound an individual can detect to a level at which an individual perceives the sound to be uncomfortable loud (Stach, 1997). A reduced dynamic range is common in individuals with sensorineural hearing impairment. Therefore compression within the HA allows soft sounds to become louder, while ensuring loud sounds do not become uncomfortably loud. HAs also include other features such as, directional microphones, digital noise reduction, feedback suppression, frequency lowering, data logging and wireless connectivity.

1.2.4.2 Hearing aid uptake

Despite the negative consequences associated with hearing impairment, the uptake of HAs is low (Davis, Smith, Ferguson, Stephens & Ginapoulos, 2007). The 2012 MarkeTrak report restated that only 25% of adults with a hearing impairment in the United States own HAs (Kochkin, 2012). The 2012 EuroTrak UK survey report a higher HA ownership rate of 42.2% of adults with hearing impairment in the United

Kingdom. Both the MarkeTrak report and the EuroTrak UK report found that the HA adoption rate is positively related to self-perceived degree of hearing impairment. The MarkeTrak report also stated that ownership rate and age are positively related, as adoption rate was found to increase, with increasing age. Garstecki and Erler (1998) and Helvik, Wennberg, Jacobsen, and Hallberg (2008) also found that hearing impairment influences HA uptake. However, Garstecki and Erler (1998) only found this difference for female adherents and non-adherents.

There are contradictory findings in the literature about whether or not an individual's attitude to hearing impairment influences rehabilitation decisions. Humes, Halling, and Coughlin (2003) found that the non-adherent group in their study, had better self-acceptance of their communication problems and less stress associated with their hearing problems compared to the adherents. However, this contradicts findings from a study by Garstecki and Erler (1998) who found that male adherents were more accepting of their hearing impairment. Furthermore, the cost of HAs has been repeatedly reported as reason for not obtaining HAs (Garstecki & Erler, 1998; Kochkin, 2007; Fisher et al., 2011). Similarly, in countries where HAs are not free or subsidised, socioeconomic status was found to be related to HA adherence (Garstecki & Erler, 1998). Fisher et al. (2011) also reported that perceived benefit, inconvenience and poor HA experience of others was related to the non-adherence of HAs.

1.2.4.3 Benefits of hearing aids

As mentioned previously, the benefits of amplification on HR-QoL are clear and robust (Chisolm et al., 2007). Chisolm et al. (2007) conducted a systematic review

of HA use and HR-QoL and found that HA use improves HR-QoL by reducing psychological, emotional and social effects of sensorineural hearing loss, an insidious, potentially harmful, chronic health condition if left unmanaged. HAs have been repeatedly associated with more positive perceptions of HR-QoL as measured by questionnaires such as the HHIE (Ventry & Weinstein, 1982), and the HHIA (Newman, Weinstein, Jacobson, & Hug, 1991). Furthermore, Meister, Walger, Brehmer, Wedel and Wedel (2008) found that most individuals expected that the use of HAs would lead to an improvement in their HR-QoL. Stark and Hickson (2004) also found that HAs not only improved the quality of life of hearing impaired individuals but also positively affected significant others. Furthermore, use of HAs has also been correlated with a reduction in depression (Acar, Yurekli, Babademez, Karabulut & Karasen, 2011; Boi et al., 2012; Metselaar et al., 2009). Researchers have also found that the benefit of HAs are sustained for at least one year after baseline in the emotional, social and communication domains (Mulrow, Tuley, & Aguilar, 1992).

1.2.4.4 Benefits of hearing assistance technology (HAT)

Very few studies have focused specifically on HAT independently without the use of HAs. To date, there is no definitive evidence that using HAT has a positive impact on HR-QoL measures, particularly hearing related AL/PR (Jerger, Chmiel, Florin, Pirozzolo, & Wilson, 1996; Yueh et al., 2011). However, there are a large number of HAT devices available for use, and more systematic research is required to determine whether or not there are relationships between the ownership of HAT and both generic and disease-specific HR-QoL.

In a study by Yueh et al. (2011) no differences were found for the HAT group and control group on HHIE scores between baseline and three month follow up; however both groups that were assigned HAs showed statistically significant reductions in their perception of AL/PR. Yueh et al. (2011) randomly assigned four different amplification conditions to four groups of 15-16 participants. Four different amplification conditions that were assigned were: programmable HAs with directional microphones (age range 50-86, mean age 68.5), HAs without directional microphones (age range 53-82, mean age 72.1), hearing assistance technology (age range 53-79, mean age of 66.6 years) and a control group with no intervention (age range 52-85, mean age 67 years). The HHIE (Ventry & Weinstein, 1982) was utilized to measure AL/PR at baseline, one month and three months post intervention.

Similarly, Jerger et al. (1996) studied 180 adults to see the effects of different amplification conditions on self-perceived AL/PR using the HHIE (Ventry & Weinstein, 1982). One hundred adults were HA users with a mean age of 74.3 (age range 60 -96) and 80 were new users with a mean age of 72 (age range 60-84). One of four conditions were randomly assigned to participants: HAs only, hearing assistance technology (remote microphones), HAs and hearing assistance technology and no intervention. The authors found that there was a statistically significant reduction in self-perceived AL/PR in all four conditions, and no statistically significant difference in outcomes for any of the four groups (Jerger et al., 1996). Another study by Demorest & Erdman (1987) found that the use of HATs (predominantly FM systems) did not lead to improvements in HR-QoL measures other than self-perceived AL/PR in participants with a mean age of 39 (age range 20 to 70). Therefore, the results of

these studies suggest that HAT has no significant impact on the perception and reporting of AL/PR by the HHIE.

1. 3 Hearing Aid Disuse

1.3.1 Overview

Not all adults who own HAs use them. Studies have found that a considerable number of fitted HAs are never or seldom used (Chia et al., 2007; Lupsakko, Kautiainen & Sulkava, 2005; Stark and Hickson, 2004; Stephens et al., 2001). The estimated proportion of HAs that have been discarded or scarcely used varies from 4.7% (Hougaard & Ruf, 2011) to 24% (Hartley, Rochtchina, Newall, Golding, & Mitchell, 2010). In 2010, MarkeTrak VIII researchers reported that 12.4% of hearing-aid owners never use their aids (Kochkin et al., 2010). The reported use of HAs is 1 in 7 for individuals over the age of 50 years and this number drops to less than 1 in 20 for adults aged 50 - 59 years (Chein and Lin, 2012). Similarly, in New Zealand the likelihood of using HAs, increases with age. Only 5% of 25–44 year olds with hearing impairment use HAs compared with 63% of adults aged 85 years and older (Greville, 2005). Twenty-six percent of New Zealand adults reportedly wear their HAs between one and four hours per day, (Jerram & Purdy, 2001) which is consistent with the EuroTrak UK 2012 data. In the literature, only a small number of studies have been specifically aimed to address the factors associated with HA disuse. Other studies have different primary aims and mention factors associated with disuse as a secondary issue. Not all studies in the literature report the number of disusers and some studies grouped disusers with occasional users. Therefore there is a lack of consistency and

robustness in the way that HA disuse has been assessed and categorized in the literature.

1.3.2 Measuring Hearing aid use

One may have thought that distinguishing between HA ‘users’ and ‘disusers’ would be straightforward, however this is not the case. There is no standard tool for measuring HA use; therefore the criterion for defining ‘disuse’ or ‘nonuse’ appears somewhat arbitrary. Some studies specify numerical cut-off points while others provide fixed-choice options to quantify HA use (e.g. never, occasionally, always).

Self-report instruments and data logging have also been used to measure HA use. Self-report instruments not only document an individual’s evaluation of HA use but also delve into an individual’s opinions about their HAs. There is no widely agreed upon self-report measure used in audiology, so researchers and practitioners alike, tend to adopt different measures (Cox & Alexander, 2002).

Self-report measures have been criticised because they are subject to socially desirable responses. This has somewhat, increased the popularity of data logging for clinicians and researchers. Current HA technology allows the HA to record the number of hours it is turned on to provide a daily average of use (Humes et al., 1996). Previous studies have found, that on average, HA users over report their daily hours of HA use, compared to data logging averages (Laplante-Lévesque, Nielsen, Jensen & Naylor, 2014). However, it is argued whether or not data logging is free from errors, as it can be inaccurate and under report daily usage, or over report daily usage, when users forget to turn their HAs off (McCreery, 2013).

1.3.3 Body Functions related to hearing aid disuse

Studies in the literature have found a wide range of audiological and non-audiological factors associated with HA use and disuse in adults. Currently, there is conflicting data in the literature about hearing sensitivity (i.e., hearing threshold level) and its influence on HA disuse. Bertoli et al. (2009) explored factors associated with successful HA provision. In this study, non-regular HA use was found to be significantly lower in individuals with moderate and severe hearing impairments. In comparison, Solheim et al. (2012) found that there was no significant relationship between HA use and degree of hearing impairment. Similarly, Hickson and colleagues (2014) found that, better ear and worse ear averages, duration of hearing impairment and presence of tinnitus had no significant effect on successful HA use amongst older adults (Hickson et al., 2014). In that study, Hickson et al. (2014) defined success with HAs as: “a minimum of one hour of daily HA use and at least moderate benefit from HAs in the situation that individual most wanted to hear better”(p. 19).

It has also been reported that HA users and disusers listed speech understanding in various situations, such as noise, as being problematic (Kochkin, 2000; Vuorialho et al., 2006b). Difficulty listening in noise is often given as a reason for why individuals stop using their HAs or use their HAs infrequently (Bertoli et al., 2009; Hartley et al., 2010; Takahashi et al., 2007; Vuorialho et al., 2006b). Bertoli et al. (2009) reported that noisy situations were indicated most often (52%) as a reason for occasional use or disuse of HAs. Similarly, in a study by Harley et al. (2010) it was also reported that 28% of disusers stopped using their HAs because of noise.

However, it is unknown whether or not the participants in the study by Harley et al. (2010) found environmental sounds too noisy or the HAs themselves.

Some studies in the literature have reported that manual dexterity influences HA use (Bertoli et al., 2009; Humes, Wilson & Humes, 2003). The dexterity required for manipulating HAs is often called finger dexterity and is defined as the ability to make skilful, rapid, controlled movements of small objects, where the fingers are primarily involved (Mathiowetz, Rogers, Dowe-Keval, Donahow, Rennells, 1986). As an individual gets older, finger dexterity tends to decline due to arthritis and frailty (Gopinath et al., 2011). Therefore, finger dexterity may affect the handling and adjustment of HAs in older individuals (Gopinath et al., 2011). Several studies have reported that HA disuse is related to self-reported difficulties managing and handling HAs (Bertoli et al., 2009; Hartley et al., 2010; Hickson et al., 2014; Lupsakko et al., 2005; Vuorialho, Sorri, Nuojua, & Muhli, 2006b). However, Hickson et al. (2014) did not find that dexterity when measured by the grooved pegboard test differentiated successful and unsuccessful HA users.

Another body function that has been reportedly related to HA use/disuse is cognition. Lupsakko et al. (2005) found differences in cognition scores for HA users and disusers as measured by the Mini Mental State Exam (MMSE). However, Hickson et al. (2014) found that participants who were unsuccessful HA users only performed worse on the memory and reasoning/judgments subtests of a cognitive screen (the Cognistat). In comparison, Öberg, Marcusson, Nägga and Wressle (2012) found no differences between HA users and disusers in cognitive skills as measured

by the MMSE, Parallel serial mental operations (PaSMO) or the paragraph recall and delayed paragraph recall tests.

1.3.4 Personal Factors related to hearing aid disuse

1.3.4.1 Demographic factors

Some studies in the literature have found that HA use is higher amongst those who self-report hearing difficulties (Cox, Alexander & Gray, 2007; Helvick et al., 2008; Hickson et al., 2014; Hosford-Dunn & Halpern, 2001; Takahashi et al., 2007; Gopinath et al., 2011). Hickson et al. (2014) and Takahashi et al. (2007) both found that successful HA users reported more hearing difficulties. It is proposed that those who perceive themselves as handicapped as a result of a hearing impairment are more likely to recognize the benefits from HA fittings (Gopinath et al., 2011; Takahashi et al., 2007). However, Öberg et al. (2012) found no differences in self-reported hearing difficulties for HA users and disusers.

One drawback in the literature for hearing aid use/disuse studies is that the vast majority of participants recruited tend to be > 65 years of age. As a result, the current literature appears to be inconclusive about the relationship between age and HA disuse. Hickson et al. (2014) studied 160 participants > 60 years with a mean age of 73 years (SD = 7.1; range 60-91). In this study, unsuccessful HA users were found to be older than successful HA users. Whereas, Bertoli et al. (2009) included participants in their study as young as 18 years of age and found that individuals aged 65 to 74 years of age were at a significantly higher risk of non-regular HA use compared to those aged < 65 or > 75 years. The mean age of participants was not reported in Bertoli et al. (2009) study, however over 50% of their study population

was reportedly >75 years of age. Other studies in the literature have found no relationship between age and HA use (Chang, Tseng, Chao, Hsu & Liu, 2008; Lupsakko et al., 2005; Solheim et al., 2012); this lack of effect is likely due to the relatively homogenous age groups within these studies.

Alongside these reasons implicated for HA disuse, a significant difference in median income for HA users and disusers has been found (Garstecki et al., 1996; Lupsakko et al., 2005). Even when HAs are free, the on-going cost of owning a HA has been associated with HA disuse (Lupsakko et al., 2005; Harley et al., 2010). Furthermore, Lupsakko et al. (2003) found that in countries where HA provision is not government funded, HA possession was positively correlated with income. Although, Stephens, Lewis, Davis, Gianopoulos and Vetter (2001) found no difference between HA use with private and publically funded HAs.

Many other demographic factors aside from the aforementioned have been reported in the HA use/disuse literature. Education level has been reportedly associated with HA adoption (Fisher et al., 2011; Helvik et al., 2008) but no significant differences have been found between hours of HA use and years of education (Hickson et al., 2014; Öberg et al., 2012). In general, marital status and culture appear to be under-studied in the HA literature. Marital status appears not to differentiate HA users from disusers (Solheim et al., 2012) and no comparative study has been performed on cultural differences in the outcome of HA provision thus far. However, Bertoli et al. (2009) did find that cultural background was related to HA use in 8707 adult participants ≥ 18 years. This study was conducted in Switzerland with German, French and Italian participants. In this study, the risk of non-regular HA use

was found to be significantly higher in German speaking individuals. Gender was also found to be a factor in this study, as females were at a significantly lower risk of non-regular use (Bertoli et al., 2009). However, other studies report no significant differences for gender and HA disuse (Lupsakko et al., 2005; Öberg et al., 2012; Solheim et al., 2012). Hickson et al. (2014) also found that those participants who were unsuccessful HA users more often experienced neutral/poor/very poor health, compared to those who were successful HA users. However, Öberg et al. (2012) found no differences between HA users and disusers for general health.

1.3.4.2 Hearing aid factors

Individuals attitudes to HAs have also been reported as a factor for HA disuse. Several studies have found that disusers often self-report no perceived benefit or need for HAs (Bertoli et al., 2009; Hartley et al., (2010); Hickson et al., 2014; Lupsakko et al., 2005; Takahashi et al., 2007). Similarly, HA use has been found to have a positive relationship with HA satisfaction (Bertoli et al., 2009; Kaplan-Neeman, Muchnik, Hildesheimer & Henkin, 2012; Uriarte, Denzin, Dunstan, Sellars & Hickson, 2005). However, studies looking specifically as satisfaction and HA disuse are scarce. Although, Bertoli et al. (2009) did find that HA disusers were more dissatisfied with their HAs than full-time and occasional HA users.

Other reported factors associated with HA disuse include comfort/fit of the HA, unpleasant side effects and experience. It is frequently cited in the literature that disusers report that they stop using their HAs because they are uncomfortable or fit poorly (Bertoli et al., 2009; Harley et al., 2010; Gopinath et al., 2011). Bertoli et al. (2009) also found that HA disusers or occasional users reported more unpleasant side

effects such as rashes, itching and pain compared to users. Duration of HA experience has also been associated with HA use, with studies finding that HA disusers have less overall experience with HAs than HA users (Bertoli et al., 2009; Hosford-Dunn & Halper, 2001).

Low self-efficacy for the use and care of HAs has also been proposed as another reason for HA disuse (Kricos, 2006). Self-efficacy is the belief in one's abilities to perform a particular task or achieve a goal (Bandura, 1995). It is not a measure of the skills an individual has but the beliefs about what they can do under different conditions with whatever skills they possess (Bandura, 1997). Bandura (1977) created the concept of perceived self-efficacy as part of a social cognitive theory and has been exhibited as an important factor for health behaviours (Bandura, 1995). Efficacy beliefs can influence how individuals feel, think, act and motivate themselves (Bandura, 1995). In audiology, self-efficacy refers to the beliefs that individuals have about managing their hearing impairment, HAs and difficult communication situations (Tye-Murray, 2009). One's sense of self-efficacy can govern an individual's experience with HAs and willingness to engage in conversations and activities (Tye-Murray, 2009).

Not surprisingly, self-efficacy can affect the efforts an individual will invest in persisting with HAs. A HA user may encounter a reduced HA self-efficacy if they have concerns about handling, adjusting or perceived benefit of their HAs (West & Smith, 2007). A person with a high sense of self-efficacy will be more persistent and determined when facing challenges or obstacles (Tye-Murray, 2009). These individuals will believe they have the skills necessary to efficiently set goals, problem

solve, plan and carry out actions, undertake rather than avoid challenging activities and be adaptive in their coping (Jennings, Cheeseman, Laplante-Lévesque, 2014). Smith and West (2006) found that individuals who remained confident in their abilities to overcome initial adjustment problems are more likely to continue using their HAs compared to those with low self-efficacy who were more inclined to discontinue use of their HAs. Hickson et al. (2014) also found that adults aged ≥ 60 years with a high self-efficacy were more likely to have successful outcomes with HAs (success with HAs was defined as >1 hour use per day and at least a moderate benefit) than those who scored lower for self-efficacy on the Measure of Audiologic Rehabilitation Self-efficacy for HAs (MARS-HA). It is thought that when an individual becomes frustrated with their HAs, the individual's confidence declines and their HAs may be used less often (West & Smith, 2007).

It is also possible that HA disusers may lack motivation, which inhibits their progress with HAs. HA disusers may not see the advantages of using HAs and therefore may not be ready to change their health related behaviours. There are several models proposed that explain health behaviours, which can provide structured frameworks for facilitating health behaviour changes. One model that has been used in audiology is the transtheoretical model (TTM) of behaviour change (Prochaska & DiClemente, 1983). The TTM of behaviour change focuses on an individual's readiness to change in adopting and maintaining healthy behaviours (Laplante-Lévesque et al, Hickson & Worrall, 2013). This model has been influential for different behaviours such as dieting and tobacco cessation (Prochaska et al., 1994). The TTM model represents health behaviour change as a progress through discrete stages and is often called the stages-of-change model. Four stages-of-change are most

commonly described: 1) precontemplation (problem denial); 2) contemplation (problem awareness and mixed ideas on the pros and cons of change); 3) action (healthy behaviour acquisition or modification); 4) maintenance (sustained healthy behaviour and relapse prevention). Progress through these stages is thought to be nonlinear with regression to earlier stages common. Help seeking, intervention uptake, adherence and successful outcomes are most prominent in the later stages-of-change.

Milstein and Weinstein (2002) pioneered the implementation of the stages-of-change model in audiology. In their study, 147 participants that took part in a hearing screen chose 1 of 4 mutually exclusive statements, with each statement representing a stage of change: precontemplation (“I do not think I have a hearing problem and therefore nothing should be done about it.”), contemplation (“I think I have a hearing problem. However, I am not yet ready to take any action to solve the problem, but I might do so in the future.”), preparation (“I know I have a hearing problem, and I intend to take action to solve it soon.”), and action (“I know I have a hearing problem, and I am here to take action to solve it now”). It was found that stages-of-change scores were not altered as a result of the screening nor did stages-of-change scores predict help-seeking in this sample. No studies in the literature have looked specifically at HA use and stages-of-change, but it is possible that HA users may be at a later stage of change than HA disusers.

1.3.5 Environmental factors related to hearing aid disuse

Some studies have found that social support or pressure from people around the individual with a hearing impairment, such as family and friends, has an impact

on intervention decisions (Cox, Alexander & Gray, 2005; Duijvestin et al., 2013; Fischer et al., 2011). A retrospective study conducted by Hickson et al. (2014) found that individuals who had greater positive support from significant others were more likely to use their HAs. However, Wilson and Stephens (2003) found that HA use was no different for individuals who were self motivated compared to those who were motivated by others.

Similarly, support provided by audiologists is thought to play a role in HA disuse. Studies in the literature vary widely with the type of counselling programmes offered. Some studies describe the effects of programmes offered along side HA fittings whereas others just look at the effects of counselling after HA fittings. Follow-up support is thought to be important for audiologists when encouraging first-time HA users to use their devices regularly (Solheim et al., 2012). Especially as the use of HAs can be attached to numerous issues other than the hearing impairment alone. Therefore clinicians need counselling skills to address the emotional aspects of hearing impairment. Importantly, regular counselling appointments have been found to decrease the number of HA disusers and increase the number of occasional users to regular users (Vuorialho, Karinen & Sorri, 2006a). Therefore counselling and support from professionals have been found to significantly reduce the percentage of HA disusers (Solheim et al., 2012; Vuorialho et al., 2006a). Kapteyn, Wijkkel and Hackenitz (1997) examined the effects on effective exchange of information and the impact of home visits on the use of HAs. It was found that home visits conducted by a trained professional resulted in a significantly lower level of non-effective HA use compared to individuals who did not receive home visits.

Another experimental study carried out by Eriksson-Mangold, Ringdahl, Björklund and Wåhlin (1990) examined the effects of a fitting programme that involved clinic visits before and after receiving HAs. The experimental group went to five visits at a Hearing Centre, had structured guidelines, carried out rehabilitative tasks between visits, and gradually increased HA use during the first month of training. The participants in the experimental group were compared to individuals who received “care as usual”. The results demonstrated that there was a significantly higher use of HAs in the experimental group compared to the control group. However, no steps were made to determine which part of the active fitting programme resulted in higher use of HAs. Overall, it appears that the need for follow-up support in the form of organized check-ups and accessibility to professionals is important.

1.3.6 AL/PR and hearing aid disuse

Studies on the relationship between AL/PR in adults with hearing impairment consistently reveal an imperfect relationship between self-report data that quantify hearing related AL/PR and hearing impairment measured audiometrically (Weinstein, Richards & Montano, 1995; Laplante-Lévesque et al., 2014b). As mentioned previously, pure tone audiometry is able to describe the level of hearing impairment; but it is unable to provide information relating to how an individual experiences their hearing impairment in everyday life. Demorest et al. (2011) stated that the difficulties an individual experiences are related to audiometric results, but the audiogram alone cannot predict the communication and adjustment difficulties experienced. Ventry and Weinstein (1982) claimed that hearing related AL/PR was not only associated with hearing impairment, but also to personal factors such as personality, physical health and psychosocial adjustment. Interestingly, Laplante-Lévesque et al. (2012)

found that greater self-reported hearing impairment was a predictor of successful HA outcomes. As mentioned previously, those individuals identified by their significant level of hearing related AL/PR maybe the ones who benefit most from HAs (Chang et al., 2009; Chew & Yeak, 2010). Consequently, these individuals may also be the ones that continually use their HAs. This was demonstrated in Hickson et al. (2014) study, as it was found that participants who said they had more hearing difficulties in everyday life prior to obtaining HAs were more likely to become successful HA users. Similarly Cox et al. (2007) reported that higher levels of unaided self-perceived AL/PR prefitting, was associated with more HA use. Likewise, Hosford-Dunn and Halpern (2001) found a positive correlation between self-perceived hearing difficulties and hearing aid use. As a result, Takahashi et al. (2007) proposed that individuals who perceive themselves as experiencing AL/PR as a result of a hearing impairment are more likely to recognize the benefits of HAs.

1.5 Study Rationale

As previously stated, hearing impairment has been found to have negative consequences in many areas of an individual's life. The prevalence of hearing impairment is one of the highest chronic nonfatal disabling conditions globally (Lopez, Mathers, Ezzati, Jamison & Murray, 2006). Very few studies have looked directly at the factors associated with HA disuse and to date, there has been no study that investigates the reasons for HA disuse in New Zealand/Aotearoa. It is therefore imperative to resolve why so many people fail to use their HAs, particularly in countries such as New Zealand where there is access to high quality audiological services. The outcomes of this study can help identify potential variables that are

related to HA disuse. By identifying these variables, audiologists may be able to reduce the prevalence of HA disuse by tailoring rehabilitation to suit the needs of the individual client. As a result, fewer individuals may experience the negative consequences of untreated hearing impairment.

1.6 Aims and Hypotheses

The aim of this study is to identify factors related to HA disuse in New Zealand.

This study aimed to test four hypotheses:

1. There will be significant body function differences between participants in the HA use and HA disuse groups. Specifically:
 - a. There will be significant audiometric differences between participants in the HA use and HA disuse groups. Specifically:
 - i. better-ear pure tone average (BEPTA)
 - ii. worse-ear pure tone average (WEPTA)
 - iii. SNR loss
 - iv. acceptance of noise
 - b. There will be significant non-audiometric differences between participants in the HA use and HA disuse groups: Specifically:
 - i. finger dexterity
 - ii. cognition

2. There will be significant personal factor differences between participants in the HA use and HA disuse groups. Specifically:

a There will be significant demographic differences between participants in the HA use and HA disuse groups: Specifically:

- i. age at fitting
- ii. age at testing
- iii. gender
- iv. ethnicity
- v. income
- vi. individuals in a household
- vii. level of education
- viii. relationship status
- ix. self-rating of hearing severity
- x. use of HAT

b. There will be significant HA variable differences between participants in the HA use and HA disuse groups. Specifically:

- i. HA satisfaction
- ii. HA subsidy
- iii. self-efficacy
- iv. unilateral vs bilateral fitting
- v. accepted need
- vi. consciousness
- vii. HA outcomes
- viii. stages-of-change

3. There will be significant environmental factor differences between participants in the HA use and HA disuse groups. Specifically:
 - a. environmental influence
 - b. follow-up support

4. There will be significant AL/PR differences between participants in the HA use and HA disuse groups. Specifically on the:
 - a. HHQ

Chapter Two: Method

2.1 Sample Size Analysis

Before starting participant recruitment, the required sample size was determined using *a priori* power analysis. Due to standard use in research, level of significance was set at .05 and statistical power at .80. An effect size of Cohen's $d = 1.0$ was used. The number of variables in the analysis was seven and the type of statistical analysis was an ANOVA. Based on this information, 29 participants were required in each group for this study.

2.2 Participants

Participants for this study were recruited from the Canterbury region in New Zealand. Participants were recruited through print and electronic advertisements placed throughout the region. A database of individuals who had been involved in previous research at Canterbury University was also used to recruit participants. Only participants in the database that had demonstrated an interest in being involved in future studies were contacted and recruited. Participants were categorized into one of two groups based on their responses to a device questionnaire. Participants who reported using their HAs for less than one hour a day were placed in the HA disuse group, while participants who reported using their HAs for one or more hours per day, were placed in the HA use group.

Individuals were eligible to participate in this study if they met certain criteria.

Participants were required to be over the age of 18 as this study looked at HA disuse among adults. Participants also needed to have a verifiable hearing impairment that was supported by a previous audiogram or hearing test conducted within the study. Therefore these participants were required to have a hearing loss that warranted fitting a HA and they needed to own at least one HA. Finally, it was important that participants were English speakers who could participate in an interview conducted in English. It was also necessary for participants to be able to fully comprehend what was required of them, and to be able to express themselves completely when completing questionnaires and answering the interview question.

2.3 General Procedure

Clients from the database were asked if they would like to participate in the study. At that time, they were provided with contact information for the researchers and were encouraged to call or email if any questions arose. Participants who responded to the advertisements were provided with information on the study and the researcher determined whether or not these individuals were eligible to participate. The information sheet, consent form and questionnaires (Appendices A - H respectively) were mailed out to all eligible participants. One week after mailing the data packet, participants were contacted and booked in for an appointment at the University of Canterbury Hearing Clinic. Participants were encouraged to bring in a previous audiogram, however those who did not have one were booked for a hearing test lasting approximately 30 minutes. All participants were asked to bring the consent form and questionnaires to the appointment.

On arrival to the clinic, the participants were taken to a room where the testing and interview could be conducted privately. Two researchers conducted all the testing and interviews independently. The researchers explained the procedures for the testing and interview and any questions the participants had were answered prior to data collection. If the participants were willing to participate in the study, the signed informed consent form was collected as well as the data packet. When participants were ready, testing began in a sound treated test room. The tests that were used in this study are detailed in the Measures section below. Those participants who required a hearing test obtained one following the clinical protocols established by the New Zealand Audiological Society (NZAS). Participants also completed the Quick Speech in Noise test (QuickSIN), Acceptable Noise Level (ANL) test, Purdue pegboard test and Montreal Cognitive Screen (MoCA). The interview was conducted and recorded using an Olympus WS-6505 digital voice recorder. The data from the interview is part of another study and will not be reported here.

2.4 Measures

The questionnaires and tests used to assess audiometric variables, finger dexterity and cognition are explained below.

2.4.1 Questionnaires

2.4.1.1 Demographic Questionnaire

A demographic questionnaire (appendix C) was included in the participant's data packets. The demographic questionnaire contained questions on the following areas: age, gender, ethnicity, severity of hearing impairment, unilateral vs bilateral

HA fitting, age of first HA fitting, HA use, satisfaction with HAs, use of HAT, level of education, occupation, annual net income, government subsidy, relationship status and number of individuals in the household.

2.4.1.2 Hearing Handicap Questionnaire (HHQ)

One way to measure hearing related AL/PR is through the Hearing Handicap Questionnaire (HHQ; Gatehouse & Noble, 2004). The questionnaire was developed partly from items from the Hearing Disabilities and Handicaps Scale (Hétu et al., 1994), and partly from items from an unpublished general health scale (Robinson et al., 1996). It is short to administer and easy to score making it suitable for use in clinical and research settings. The HHQ can be used with adults of all ages to determine an individual's self-perceived handicap. The questionnaire measures emotional distress and discomfort, general restrictions on participation and social withdrawal. Wording in the questionnaire was adjusted to ask specifically about effects of hearing impairment (Gatehouse & Noble, 2004). The content of each item is independent of any distinct listening situation. Psychometric testing of the HHQ revealed good internal consistency (Cronbach's $\alpha = 0.93$) (Hickson et al., 2007) and a single factor structure (Gatehouse & Noble, 2004).

The HHQ was included in the participant's data packets. Participants were asked to select: 'never', 'rarely', 'sometimes', 'often', or 'almost always' in response to 12 questions related to their hearing. Example items include: "How often does your hearing difficulty make you feel nervous or uncomfortable?" and "How often does your hearing difficulty restrict your social or personal life?" Answers were scored: 1 for 'never', 2 for 'rarely', 3 for 'sometimes', 4 for 'often' and 5 for 'almost always'.

Total scores on the questionnaire range from 12 to 60 with higher scores indicating greater participation restrictions (Hickson et al., 2007).

2.4.1.3 International Outcome Inventory for Hearing Aids (IOI-HA)

Cox et al. (2000) developed a short set of generally applicable items for self-assessment of HA fitting outcomes, called the International Outcome Inventory for HAs (IOI-HA). The IOI-HA was designed to supplement other outcome measures. The original items of the IOI-HA were composed in English and since then have been translated into different languages. One particular advantage of using the IOI-HA, is that there are a number of publications in the literature that have results for large samples of individuals (Hickson, Clutterback & Khan, 2010).

The goal of the IOI-HA is to quantify the outcome of a HA fitting from the client's point of view by addressing different outcome domains. The IOI-HA was constructed to minimize literacy and cognitive demands and can therefore be administered in paper and pen format. The questionnaire is self-explanatory and therefore no formal instructions are required.

Cox, Alexander and Gray (2003) set out to develop norms for the original American English language version of the IOI-HA. Two sets of norms were constructed for the IOI-HA: one for individuals who report mild or moderate hearing problems without amplification, and another for those who report moderately severe or severe subjective hearing problems without amplification. Through this study it was found that subjective hearing problems without amplification had the most extensive association with the responses on the questionnaire (Cox et al., 2003). It

was also found that the level of difficulty individuals experienced in their own lives was more useful in predicting HA fitting outcomes than audiological measures. However, Hickson et al. (2010) found a small but significant effect of the audiogram, as those with greater degrees of hearing impairment reported better outcomes. Additionally, Hickson et al. (2010) found that: 1) overall fit/comfort of the HAs, 2) clarity of the tone and sound and 3) comfort with loud sounds, were most strongly associated with more positive outcomes on IOI-HA and that age, gender, funding source, unilateral vs bilateral fittings, style of HA and microphone technology were not correlated with IOI-HA scores. It was also reported that experienced HA wearers reported better outcomes on the IOI-HA (Cox & Alexander, 2000; Hickson et al., 2010). Furthermore, Heuermann et al. (2005) found that the time taken from the HA fitting to completing the IOI-HA can influence potential responses on items in the questionnaire. Therefore an individual's results on the questionnaire may vary depending on whether or not the IOI-HA was filled in during the final appointment or after purchasing and wearing the HAs for several months or thereafter.

The IOI-HA was included in the participant's data packets. As previously mentioned, the IOI-HA consists of seven items which address the main dimensions of HA fitting outcomes: 1) HA daily use, 2) benefit, 3) residual activity limitations, 4) satisfaction, 5) residual participation restrictions, 6) impact on others, and 7) quality of life. Each item has a five-point response scale, with higher scores reflecting more positive outcomes. Participants were asked to tick one of the five boxes that best answered the question. Responses from left to right were assigned a value of 1 to 5, overall scores can range from 7 to 35. The values were added from the seven questions and scores. A higher score indicated more favourable outcomes.

2.4.1.4 Hearing Aid Questionnaire (HAQ)

Instruments measuring motivation in the literature are scarce (Wilson & Stephens, 2003). Therefore Solheim et al. (2012) developed a questionnaire to assess the motivational factors for HA use among individuals who had been fitted with HAs. To develop the questionnaire, six focus interviews were completed with 42 hearing-impaired adults aged 65 years or older. Based on these interviews, a 17-item questionnaire was constructed by a group of technical, medical and educational audiologists. Eight participants then completed this questionnaire as part of a pilot study. No further changes were required.

The items that make up the questionnaire describe different aspects of experiences related to HAs and former follow-up visits. Factor analysis suggested that the questionnaire is composed of four dimensions: “accepted need” – defined as the acknowledged need for HAs (Items 1 to 8) (Cronbach’s alpha: 0.869); “follow-up support” (Items 9 to 13) (Cronbach’s alpha: 0.900); “social assessment” – defined as the environment’s influence on the individual’s experience of hearing impairment (Items 14 and 15) (Cronbach’s alpha: 0.552); and “consciousness” – described as the respondent’s attitude towards HAs and hearing impairment (Items 16 and 17) (Cronbach’s alpha: 0.505). Cronbach’s alpha was considered low for Factors 3 and 4, but in total the four factors explained 68.1% of the total variance.

The HAQ was included in the participant’s data packets. Participants were asked to rank their agreement with each statement on a scale from 0 (completely agree) to 10 (completely disagree). Each item from the questionnaire was separated

into four factors: accepted need, follow up support, social assessment and consciousness. Item scores from 2, 3, 5, 6, 8, 15, 16, and 17 were summed to form the accepted need score. The accepted need score ranges from 0-80. Item scores from 1, 7, 11, 12 and 13 were summed to form the follow-up support score. The follow-up support score ranges from 0-50. The social assessment score was calculated by summing items 9 and 10 and ranges from 0-20. The consciousness score was calculated by summing items 4 and 14 and ranges from 0-20.

2.4.1.5 Self-Efficacy of Situational Management Questionnaire (SESMQ)

One way to measure self-efficacy is through a questionnaire called the Self-Efficacy for Situational Communication Management Questionnaire (SESMQ) (SESMQ; Jennings, 2005). The SESMQ was designed to measure perceived self-efficacy for managing communication in everyday listening environments (Jennings et al., 2014). Perceived communication self-efficacy on the SESMQ is thought of as an individual's judgment of their capabilities to mobilize the motivation, cognitive resources and courses of action required to meet the demands of a variety of difficult everyday listening environments.

Items in the SESMQ include both public and private environments as well as familiar and unfamiliar communication partners. This ensures that a range of communication environments is sampled (e.g., You are at a party where the conversation is noisy. Someone who you have never met before comes over to speak to you.) (Jennings et al., 2014).

The SESMQ has been found to be a reliable and valid instrument. Jennings et al. (2014) reported that the SESMQ is a reliable measure as it has a high test-retest reliability. Content validity of the SESMQ was assessed by five audiologists and five adults with acquired hearing impairment. The final version of the SESMQ was found to have a Content Validity Index score of 0.86 (Jennings et al., 2014). The SESMQ was also found to have a high internal consistency, indicated by a high Cronbach's α of 0.96 for the overall questionnaire, 0.93 for the hearing ability scale and 0.94 for the confidence scale; indicating that the overall questionnaire and subscales are related (Jennings et al., 2014).

The SESMQ was included in the participant's data packets. Participants were required to rate 20 items on two scales. On the first scale, participants rated how well they can hear in certain situations from 0 (not well at all) to 10 (very well); this is called the *hearing ability scale* (SESMQH). The second scale required respondents to rate their degree of confidence in managing that situation from 0 (not confident at all) to 10 (very confident); this is called the *confidence Perceived self-efficacy (PSE) scale* (SESMQC). Scores were summed across the 20 questions for the hearing ratings and confidence ratings. The highest overall score that could be obtained was 200, with higher scores indicating greater hearing ability and greater confidence (Jennings et al., 2014).

2.4.1.6 University of Rhode Island Change Assessment (URICA)

As mentioned previously, one way of measuring stages-of-change is through a generic measure, called the University of Rhode Island Change Assessment (URICA; McConaughy et al., 1983). The URICA has been reported to have good test-retest

reliability and its factor structure has been confirmed in numerous samples (Laplante-Lévesque et al., 2014). Cronbach's alpha has been found to be high for all four stages (precontemplation, contemplation, preparation, action) suggesting that each stage's items are highly intercorrelated and measure the same construct (Laplante-Lévesque et al., 2013; 2014). However, some studies have found inconsistencies, questioning the construct validity of the stages-of-change model and its measures (Tambling & Ketring, 2014).

To date, there have only been a handful of studies that have utilized the URICA with hearing impaired participants. There is one sample group that has been used in three separate studies (Laplante-Lévesque et al., 2011; 2012; 2013). In these studies, URICA results were obtained through interviews, from 153 adults aged 50 and above, seeking help for the first time. These participants were offered treatment in the form of communication programs or HAs (Laplante-Lévesque et al., 2011; 2012; 2013). Laplante-Lévesque et al. (2011) demonstrated that for adults with hearing impairments seeking help for the first time, stages-of-change scores were not associated with intervention decisions. However, Laplante-Lévesque et al. (2012) found that with the same sample group, there was an association with stages-of-change scores and intervention uptake and outcomes. As the individuals in these studies were seeking help for the first time the eight URICA items relevant to the maintenance stage were excluded since they were considered to be unrelated. The remaining 24 items of the URICA targeted precontemplation, contemplation and action. Studies by Laplante-Lévesque et al. (2013; 2014) have found four principal components via analysis (precontemplation, contemplation, preparation, and action) instead of three stages, for which the internal consistency was good. The additional

preparation stage is in line with previous research, and is made up of five items on the contemplation stage, which targets information seeking and need for professional guidance toward behaviour change (Laplante-Lévesque et al., 2013).

Most participants (80%) in the 2013 study scored highest on the action stage, which is not surprising giving that participation in the study is considered an initial help-seeking step. It was also found that participants, who reported a more advanced stage of change, reported both greater duration and degree of hearing disability as well as a more severe hearing impairment. Furthermore, participants who reported a more advanced stage of change were more likely to take up HAs or communication programs and were more likely to report successful outcomes (Laplante-Lévesque et al., 2013). Laplante-Lévesque et al. (2013) further reported that these changes maybe better represented on a continuum rather than discrete movements from one step to another. The most recent study by Laplante-Lévesque et al. (2014) looked at 224 adults who failed a Swedish online hearing-screening test and completed further questionnaires online, including the URICA. Unlike the 2013 study, the largest proportions of participants (50%) were in the preparation stage of change, with only 3% of participants being in the action stage. This indicates that screening alone is unlikely to improve help-seeking and rehabilitation rates. Similar to the 2013 study, participants who had a more advanced stage of change had significantly greater self-reported hearing disability. However, these participants did not have worse speech in noise recognition scores, nor did they report a significantly longer period of hearing impairment (Laplante-Lévesque et al., 2014).

The modified version of the URICA created by Laplante-Lévesque et al. 2013 was included in the participant's data packet. This modified version of the URICA consist of 32 items, with 8 items for each stages-of-change: precontemplation (e.g., Being here is pretty much a waste of time for me because the problem doesn't have anything to do with me), contemplation (e.g., I think I might be ready for some self-improvement for my problem), action (e.g., I am working really hard to change), and maintenance (e.g., I have been successful in working on my problems but I am not sure I can keep up the efforts on my own). Participants were asked to select: 'strongly disagree', 'disagree', 'undecided', 'agree', and 'strongly agree' in response to 24 questions relating to their hearing. Answers were scored 1 for 'strongly disagree', 2 for 'disagree', 3 for 'undecided', 4 for 'agree' and 5 for 'strongly agree'. Each item from the questionnaire was separated into four factors: precontemplation, contemplation, preparation and action. Item scores from 1, 5, 8, 9, 11, 21, 22, and 24 made up the precontemplation stage. Item scores from 2, 4 and 13 made up the contemplation stage. The preparation stage was made up from items 7, 9, 10, 15 and 17 and the action stage was made up from items 3, 6, 8, 12, 14, 16, 20 and 23. Overall stage scores ranged from 8 to 40, with higher scores indicating a greater endorsement for the relevant stage of change. The readiness composite score was obtained by adding the URICA's average contemplation, preparation and action stage scores and subtracting the average precontemplation stage score.

2.4.2 Audiometric variables

Three audiometric variables were used in this study: hearing impairment, speech in noise and acceptance of noise. The method of measurement for each variable is explained below.

2.4.2.1 Hearing Impairment

Following otoscopy, pure tones were presented to the participant using a calibrated Grason-Stadler GSI 61 clinical audiometer via ER-3A Insert earphones or TDH-39 Supra-aural earphones for air conduction thresholds and a RadioEar BC 71 bone vibrator for bone conduction thresholds. Thresholds were obtained at octave intervals between 250 and 8000 Hz for air conduction and between 500 and 4000 Hz for bone conduction. Masking was required for air conduction if at any given frequency the differences between the pure tone air conduction thresholds were equal to or greater than 75 dB HL for 250 Hz to 1000 Hz or 50 dB HL for 2000 Hz to 8000 Hz for insert earphones or equal to or greater than 40 dB HL for supra-aural earphones. Masking was required for bone conduction if the difference between the pure tone air conduction threshold and the pure tone bone conduction threshold was 15 dB HL or greater. The participant's degree of hearing impairment was determined using the puretone average of the better ear (BEPTA). Better hearing is characterized by a lower BEPTA, and this variable was calculated by averaging the pure tone air conduction thresholds at 500, 1000, 2000 and 4000 Hz. The pure tone average of the ear with worse hearing is referred to as the worse ear PTA (WEPTA) and this variable was also calculated by averaging the pure tone air conduction thresholds at 500, 1000, 2000, and 4000 Hz in the worse hearing ear.

2.4.2.2 Quick Speech in Noise (QuickSIN)

The Quick Speech in Noise (QuickSIN) test was administered to measure the participant's ability to understand speech in noise. The QuickSIN provides an estimate of an individual's signal-to-noise ratio (SNR) loss (Killion, Niquette,

Gudmundsen, Revit, & Banerjee, 2004). This ratio cannot be reliably predicted from pure tone data (Killion & Niquette, 2000). The SNR loss is analogous to hearing impairment in that it represents the dB increase in signal-to-noise ratio required by an individual to understand speech in noise compared with individuals who have normal hearing. The QuickSIN test is a shortened, revised version of the Speech in Noise (SIN) test and is made up of twelve lists of sentences, with six sentences within each list. It was developed to resolve problems with the SIN test reported by clinicians and researchers, such as difficulty with scoring and administration time (Killion et al., 2004). The QuickSIN uses the Harvard Institute of Electrical and Electronics Engineers (IEEE;1969) sentences. These sentences are a collection of meaningful, low-context sentences with a phonetic balance similar to that of English.

SNR loss is calculated using the following formula: $\text{SNR loss} = 25.5 - \text{Total Words Correct}$. This formula was derived from the Tillman and Olsen method for obtaining spondee thresholds (Tillman & Olsen, 1973) as reported by Killion and colleagues (2004). In this method, the commencing level is added to one-half of the step size. The total number of words repeated correctly is subtracted from this sum to obtain the speech recognition threshold. The highest SNR in the QuickSIN is 25 dB and the step size is 5 dB. Killion and colleagues (2004) derived the formula $27.5 - \text{total number of words repeated correctly}$ to obtain SNR-50 from the Tillman and Olsen (1973) formula. This formula is a measure of the signal-to-noise ratio required for listeners to correctly repeat 50% of the words. Because the SNR-50 for listeners with normal hearing is 2 dB, this amount is subtracted from the SNR-50 formula to obtain SNR loss: $25.5 - \text{total words correct}$. Killion and colleagues reported that when

using a single QuickSIN list, the 95% confidence interval is ± 2.7 dB (Etymotic Research, 2001). To decrease the size of the confidence interval and to increase accuracy, multiple lists can be averaged to obtain the SNR loss. For four QuickSIN lists, Killion and colleagues reported the 95% confidence interval as ± 1.4 dB.

Participants were required to listen to one practice list and two test lists. After each sentence was presented participants were required to repeat what they heard. Each sentence contained five key words that were awarded one point for being correct and zero points for being incorrect. These sentences were presented binaurally with a competing background of four-talker babble (Killion et al., 2004) through either insert or supra-aural earphones. The sentences in each list were presented at signal-to-noise ratios decreasing in 5dB steps from 25 to 0 dB (25, 20, 15, 10, 5, 0 dB). For participants with a PTA of ≤ 45 dB HL, the presentation level of the sentences was 70 dB HL, whereas for those participants with a PTA > 45 dB HL, the presentation level was set to “loud but ok” (Valente & van Vliet, 1997). The SNR loss from the two test lists were averaged to determine the average SNR loss for each participant.

2.4.2.3 Acceptable Noise Level (ANL)

The Acceptable Noise Level (ANL) Test was the final audiometric variable measured in this study. The ANL is a measure of the amount of background noise that an individual is willing to tolerate (Nabelek, Tucker & Letowski, 1991). The ANL test was designed to predict whether or not an individual will be a successful HA user by establishing how much an individual will accept noise within a speech signal.

According to Nabelek, Freyaldenhoeft, Tampas, Burchfield & Muenchen, (2006) there are three different ANL categories – low, mid, and high. Individuals who have “low” ANLs (less than 7 dB) are generally successful HA wearers, whereas individuals who have “high” ANLs (greater than 13 dB) are generally unsuccessful HA wearers. Individuals with “mid” ANLs (7 to 13 dB) may or may not be successful with HAs. Nabelek et al. (2006) further reported that most hearing-impaired individuals have ANLs between 0 and 25 dB and that the most commonly occurring ANLs are around 10–11 dB.

Participants were provided with an A4 sheet of written instructions for the test. Running speech was presented to participants via insert or supra-aural earphones. The Arizona Travelogue was used as the speech stimulus (Cosmos, Inc.). This passage consisted of continuous discourse by a male talker discussing his travels in Arizona. Using an adaptive procedure, participants were instructed to inform the researcher when speech at a certain level was “too loud” then “too soft” then “most comfortable.” When a participant indicated that the signal was “most comfortable” this was recorded as the participant’s most comfortable listening level (MCL). Background noise in the form of multi-talker babble was then added to the MCL speech stimulus. Participants were then instructed to indicate when the background noise became “too loud to understand the speech” then to indicate when the level was “soft enough for the speech to be very clear” and then finally to indicate the highest level that the participant was “willing to put up with” while following the speech. The level that a participant was “willing to put up with” was recorded as their maximum tolerated background noise level (BNL). The difference between the participant’s most comfortable listening level (MCL) and their maximum tolerated background

noise level (BNL) was their ANL score. This test took about 2–3 minutes to administer.

2.4.3 Purdue Pegboard Test

One way of measuring finger dexterity is through the Purdue Pegboard Test (Tiffin & Asher, 1948). This test was designed in the 1940s as a tool to screen for hand dexterity in individuals who were applying for industrial jobs (Amirjani, Ashworth, Olsen, Morhart & Chan, 2011). This test assesses fine motor hand function using pegs, washers and collars. The board consists of two adjacent, vertical rows of small holes into which metal pegs may be inserted. The test consists of four subtests: right hand, left hand, both hands and assembly. Scoring may be obtained for the left hand alone, right hand alone, for both hands working together and for a total of left hand, right hand and both hands (assembly) (Amirjani et al., 2011).

The Purdue Pegboard Test has a long history and wide use; therefore there are well-established normative values and test-retest reliability results for healthy individuals (Amirjani et al., 2011). The test has gained popularity as a dexterity assessment tool in medical research as it is easy to administer, employs tasks that are similar to activities of daily living, and is economical. A literature search found that two studies in audiology have reportedly used the Purdue Pegboard Test. Kumar, Hickey & Shaw (2000) used the test to determine whether or not finger dexterity is correlated with the successful use of a HA. Thirty HA users between 65 and 85 years were tested with the Purdue Pegboard Test and this result was compared to the benefit obtained from using a HA as assessed by a non-standardized questionnaire. A comparison was made for individuals who wore ‘behind the ear’ and ‘in the ear’ HAs.

The results demonstrated that there was a correlation between manual dexterity and successful use of a HA when the 30 individuals were considered as a whole.

However, no correlation was found for the ‘in the ear’ group alone.

The Purdue Pegboard Test was also used by Harris, Eckert, Ahlstron & Dubno (2009) to examine the effects of age on processing speed. The aim of this study was to determine what factors contribute to the differences in gap detection for younger and older adults. Using the Purdue Pegboard Test, it was found that there was a significant age-related slowing of processing speed. This helped researchers determine that age-related differences in complex measures of auditory temporal processing may be explained, in part, by age-related deficits in attention and processing speed.

For this study, participants were required to complete all four subtests twice, while being timed by the researcher. The subtests were: right hand, left hand, both hands and assembly. Participants were instructed that this was a timed test to determine accuracy and speed. Prior to beginning each subtest, participants were encouraged to practice the task. Participants began testing with their dominant hand and placed pins one at a time with this hand from the cup on the dominant side of the pegboard. They placed the pin at the top hole, and continued to place each pin in the dominant-handed row for 30 seconds. The number of pins were counted and recorded. These steps were then repeated for the participants’ non-dominant hand for the second subtest. Participants used the pegboard row and cup on the non-dominant side for subtest two. The third subtest required the participants to use both hands at the same time to place the pins in adjacent rows on the board, starting with the top holes on the pegboard. Cups filled with pegs were placed on each side of the pegboard for subtest

three. Thirty seconds was also allowed for this subtest. The number of pins in the rows were counted and recorded. The fourth subtest required the participants to assemble a pin, washer, collar and washer into the top hole on their dominant side of the pegboard. Participants used their dominant hand for the pin and collar and their non-dominant hand for the washers. One cup for the pins and one cup for the collars were placed on the participant's dominant side of the pegboard and a cup filled with washers was placed on the participant's non-dominant side of the pegboard. Participants were given 1 minute to complete as many assemblies as possible. The numbers of parts assembled were recorded (each assembly was awarded 4 points).

2.4.4 Montreal Cognitive Assessment (MoCA)

One of the most commonly used neurocognitive instrument is the Mini mental state exam (MMSE). It was developed as a brief 30-item measure of cognitive status for hospitalized patients (Folstein, Folstein & McHugh, 1975). This instrument has exhibited poor test-retest reliability with healthy participants and has questionable usefulness for differential diagnosis among impaired individuals (Strauss, Sherman, & Spreen, 2006; Tombaugh, 2005). Spencer et al. (2013) also found that MMSE scores exhibited ceiling effects as well as poor sensitivity to mild cognitive impairments (Spencer et al., 2013; Strauss et al., 2006). This drawback is likely due to the ease at which most individuals can perform the MMSE tasks, as only severe impairments would prevent individuals from correctly answering most test items. To address these problems, the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005) was developed as a tool to screen individuals who present with mild cognitive complaints who usually perform in the normal range on the MMSE. The MoCA was designed to be quick and easy to administer by nonspecialists (Dalrympe-Alford et al., 2010).

Like the MMSE, the MoCA takes approximately 10 minutes to complete, has a total of 30 possible points and takes 1 minute to score. The test is divided into eight cognitive domains: visospatial abilities, short-term memory, executive functioning, concentration, attention, working memory, orientation to time and place and language. A score of > 26 is considered normal. It is said to be more sensitive than the Mini Mental State Exam (MMSE) for detecting mild cognitive impairments and has been found to have a very high internal consistency, good test-retest reliability and inter-rater reliability (Nasreddine et al., 2005).

Markwick et al. (2012) found that the majority of individuals in their study who fell below the cut-off score of 26 on the MoCA performed poorer on recall, abstraction, visospatial and executive function, repetition, verbal fluency, calculation tasks and orientation tasks. Damian et al. (2011) reported similar results as well as outlining that the orientation item of the MoCA was most strongly correlated with cognitive impairment. Damian et al. (2011) also noted that the animal naming item was too easy and that the delayed recall task was too difficult in their study population.

Cognitive function was screened with the original, English version of the MoCA. Participants were required to follow the researcher's instructions without the researcher assisting or prompting the participants in any way. Test instructions were repeated only once. Visuospatial abilities were assessed using a clock drawing task and by copying a three dimensional cube. Executive functions were assessed using an alternation task by drawing a line from a number to a letter in ascending order. Naming was assessed using three common animals (lion, camel, rhinoceros).

By repeating a list of digits in forward and backwards order, a target detection task, as well as a serial subtraction task and attention abilities were evaluated. Language was assessed via repetition of two syntactically complex sentences and a fluency task. Abstraction was evaluated using a similarity task. Lastly, orientation to time and place was evaluated. The published cut off score of 26 was used to establish cognitive impairment. The screening took approximately 10 minutes to complete.

2.5 Statistical Methods

Hypothesis 1a was tested by conducting a multivariate analysis of variance MANOVA followed by an univariate analysis of variance (ANOVA) on all variables. Hypothesis 1b was tested by conducting a MANOVA followed by an ANOVA on the Purdue Pegboard Test and a Chi Square test on the MoCA. Hypothesis 2a was tested by conducting a MANOVA and ANOVA and Chi Square tests. MANOVAs and ANOVAs were used to test the between-group differences for the continuous variables (age at HA fitting, age at testing, self-rating of severity, individuals in the household). Chi Square tests were used to test the between-group differences for the categorical variables (gender, ethnicity, relationship status, level of education, HAT use). Hypothesis 2b was also tested by conducting MANOVAs and ANOVAs, Chi Square tests and a t-test. MANOVAs and ANOVAs was used to test the between-group differences for the continuous variables (HA satisfaction, self-efficacy, accepted need, consciousness). Chi Square tests were used to test the between-group differences for the categorical variables (bilateral HA fitting, application for a subsidy, self-efficacy). The IOI-HA was submitted to an independent t-test. Hypothesis 3 was tested by conducting MANOVAs and ANOVAs and Hypothesis 4

was tested by an independent t-test. Following the hypothesis testing, continuous variables that were found to be significantly different between the groups were entered into a discriminant analysis to identify which variables are most important in discriminating HA users and disusers.

2.6 Ethical Considerations

Ethical approval was granted by the University of Canterbury Human Ethics Committee on 23rd May 2014 (Appendix I). All procedures were carried out in accordance with this approval and all participants signed informed consent forms.

Chapter Three: Results

3.1 Description of Participants

A total of 70 adults with hearing impairment participated in this study: 35 adults who were HA users, and 35 adults who were HA disusers. The age of the HA users ranged from 50 to 91 years. The mean age for this group was 72.91 years ($SD = 8.05$). The age of the HA disusers ranged from 41 to 79 years. The mean age for this group was 62.80 years ($SD = 8.47$). There were 23 males and 11 females in the HA use group; and 15 males and 20 females in the HA disuse group. The self-identified ethnicity for 69 participants was “New Zealander/European.” One participant in the HA use group self-identified as “Māori.”

3.2 Comparison of Groups

3.2.1 Body Functions Variables

Hypothesis 1 stated: There will be significant body function differences between participants in the HA use and HA disuse groups. Specifically: (a) audiometric variables and (b) non-audiometric variables.

3.2.1.1 Audiometric Variables

Hypothesis 1a stated: There will be significant audiometric differences between the HA use and HA disuse groups. Specifically: (i) BEPTA (ii) WEPTA (iii) SNR loss and (iv) ANL. This hypothesis was partially supported as SNR loss and ANL were found to be significantly different between groups.

Descriptive statistics for the audiometric variables are shown in Table 1. A multivariate analysis of variance (MANOVA) was performed to determine between-group differences on all audiometric variables. The MANOVA revealed that participants in the two groups differed significantly on the set of variables, Wilks $\Lambda = .407$, $F(4,58) = 21.15$, $p < .001$. Box's $M = 53.46$, $p < .001$, indicating the equality of variance assumption had been violated, however this study had a relatively large sample size and the MANOVA was followed up with post hoc testing. The following multivariate effect size was calculated for the set of variables: $\eta^2 = 0.909$ and the observed power was $1 - \beta > .999$. Univariate analyses of variance (ANOVA) were used to determine which of the variables were contributing to the differences between the groups. With $\alpha_E = .05$, an $\alpha = .0125$ was used for each univariate test. Levene's tests indicated that the assumption of homogeneity of variance was not violated for any of the univariate ANOVA tests.

Table 1. Descriptive Statistics for the audiometric variables

Variable	Minimum	Maximum	Mean	SD
Hearing aid users				
BEPTA	10.00	83.30	37.87	10.34
WEPTA	11.67	115.00	48.33	24.71
SNR loss	2.00	29.50	12.02	6.99
ANL	1.00	14.00	7.00	4.71
Hearing aid disusers				
BEPTA	1.67	50.00	28.39	12.40
WEPTA	11.60	115.00	41.55	19.80
SNR loss	-2.50	7.00	2.67	2.09
ANL	0.00	12.00	4.00	2.91

Note. BEPTA = Better Ear Pure Tone Average; average of 500, 1000 and 2000 Hz in the better ear, WEPTA = Worse Ear Pure Tone Average; average of 500, 1000 and

2000 Hz in the worse ear, SNR = Signal-to-Noise Ratio, ANL = Acceptable Noise Level.

3.2.1.1.1 Non-significant Variables

Better ear PTA was not significantly different between the HA users and disusers ($p = .131$, $\eta^2 = .037$). Similarly, worse ear PTA was not significantly different between the HA users and disusers ($p = .677$, $\eta^2 = .003$).

3.2.1.1.2 Significant Variables

HA users had significantly greater SNR loss than HA disusers ($p < .001$, $\eta^2 = .468$). These data are shown in Figure 2. HA users had significantly greater ANL scores than HA disusers ($p = .003$, $\eta^2 = .134$). These data are shown in Figure 3.

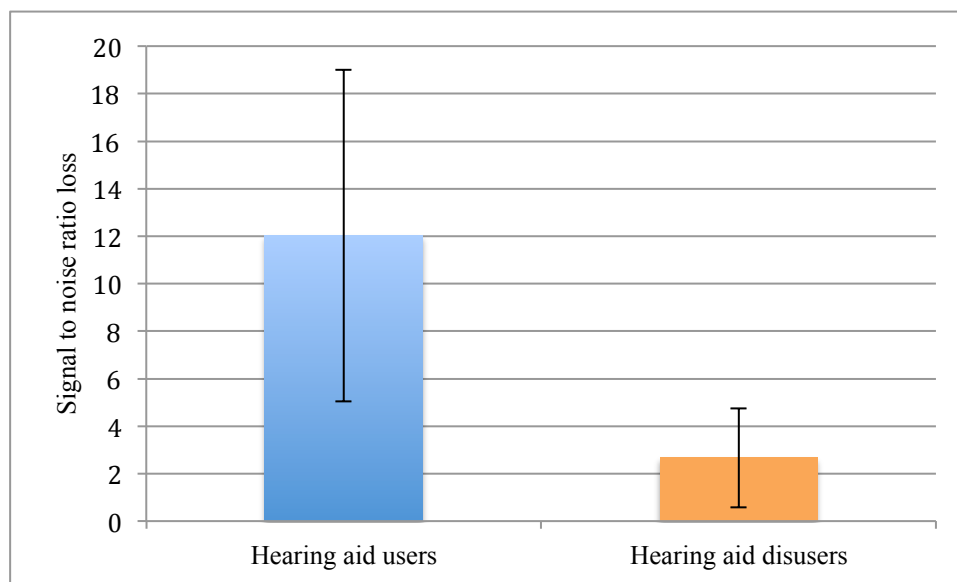


Figure 2. Means and standard errors for signal to noise ratio (SNR) loss measured by the Quick Speech in Noise Test (QuickSIN) for hearing aid users and disusers

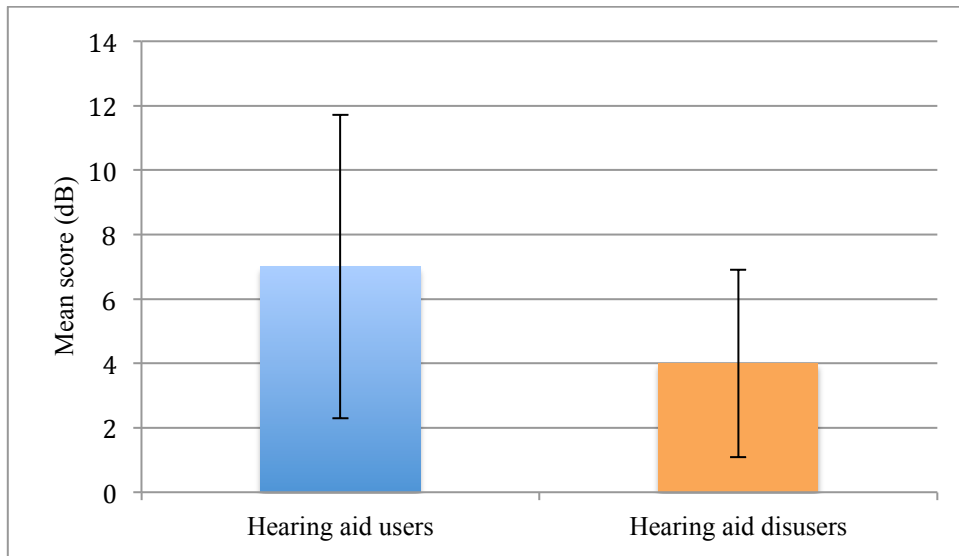


Figure 3. Means and standard errors on the Acceptable Noise Level (ANL) Test.

3.2.1.2 Non-Audiometric Variables

Descriptive statistics for the dexterity variables are shown in Table 2. A multivariate analysis of variance (MANOVA) was performed to determine between-group differences on the four dexterity variables.

Table 2. Descriptive statistics for the dexterity variables

Subtest	Minimum	Maximum	Mean	SD
Hearing aid users				
Dominant hand	10	18	12.87	1.89
Non-dominant hand	10	15	11.63	1.36
Both hands	6	19	9.12	2.49
Assembly	11	43	22.33	7.63
Hearing aid disusers				
Dominant hand	9	17	12.57	2.25
Non-dominant hand	7	17	11.54	3.03
Both hands	5	15	9.36	2.21
Assembly	10	32	20.54	7.53

3.2.1.2.1 Non-significant Variables

The MANOVA revealed that participants in the two groups did not differ significantly on the set of variables, Wilks $\Lambda = .967$, $F(4,61) = .528$, $p = .715$. Box's $M = 50.39$, $p < .001$, indicating the equality of variance assumption had been violated.

3.2.1.2.2 Significant Variable

HA disusers were more likely to pass the MoCA ($\chi^2 = 10.44$, $p = .002$). The percentage of HA users and disusers who passed the MoCA is displayed in Figure 4.

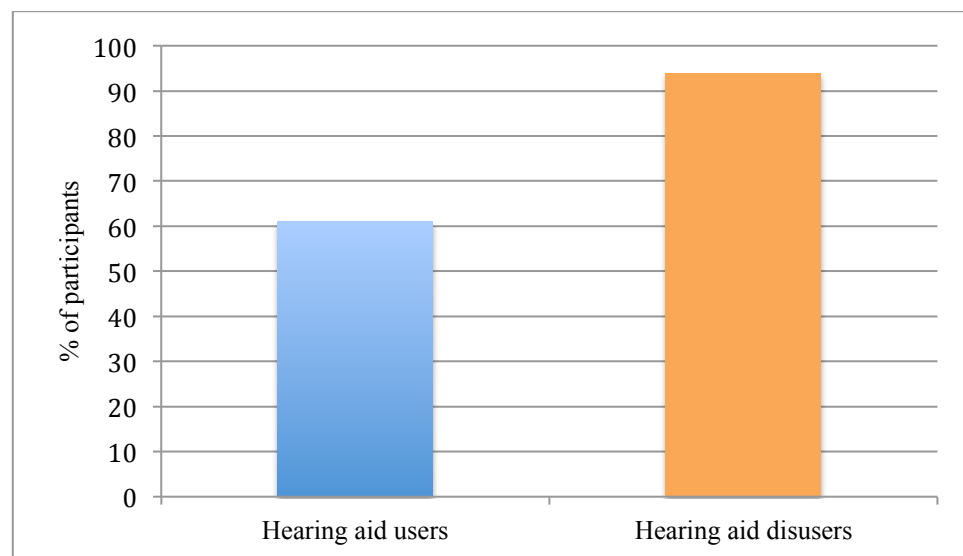


Figure 4. Percentage of hearing aid users and disusers who passed The Montreal Cognitive Assessment (MoCA).

3.2.2 Personal Factors

Hypothesis 2 stated: There will be significant personal factor differences between participants in the HA use and HA disuse groups. Specifically: (a) demographic variables and (b) HA related variables.

3.2.2.1 Demographic Variables

Hypothesis 2a looked specifically at: (i) age at fitting, (ii) age at testing, (iii) gender, (iv) ethnicity, (v) income, (vi) individuals in household, (vii) level of education, (viii) relationship status, (ix) self-rating of hearing severity and (x) use of HAT. Part 2a of the hypothesis was partially supported, as the age of participants at testing, level of highest qualification and the use of hearing assistance technology (HAT), were found to be significantly different between the groups.

Descriptive statistics for continuous demographic variables are shown in Table 3. A multivariate analysis of variance (MANOVA) was performed to determine between-group differences on the following demographic variables: (1) age at HA fitting (2) age at testing (3) self-rating of hearing loss severity and (4) number of individuals in the household. The MANOVA revealed that participants in the two groups differed significantly on the set of variables, Wilks $\Lambda = .019$, $F(4,65) = 150.35$, $p < .001$. Box's $M = 157.884$, $p < .001$, indicating the equality of variance assumption had been violated, however this study had a relatively large sample size and the MANOVA was followed up with post hoc testing. The following multivariate effect size was calculated for the set of variables: $\eta^2 = 0.981$ and the observed power was $1 - \beta > .999$. Univariate analyses of variance (ANOVA) were used to determine which of the variables were contributing to the differences between the groups. With $\alpha_E = .05$, an $\alpha = .01$ was used for each univariate test. Levene's tests indicated that the assumption of homogeneity of variance was not violated for any of the univariate ANOVA tests.

Table 3. Descriptive statistics for the continuous variables for hearing aid users and disusers

Variables	Minimum	Maximum	Mean	SD
Hearing aid users				
Age at HA fitting	10	70	54.02	16.35
Age at testing	58	91	72.91	8.05
Self-rating of severity	2	10	6.22	1.75
People in household	1	3	1.74	.50
Hearing aid disusers				
Age at HA fitting	27	73	57.74	9.55
Age at testing	41	79	62.80	8.47
Self-rating of severity	2	9	5.51	1.80
People in household	1	2	1.95	.23

Note. HA = Hearing Aid.

Frequency counts of the categorical demographic variables for income, relationship status, level of education and use of HAT are shown in Table 4. Chi square tests were used to test for significant differences between the groups on the following categorical demographic variables: (1) gender, (2) ethnicity, (3), income, (4) relationship status, (5) level of education and (6) use of HAT.

Table 4. Frequency counts for the categorical demographic variables for hearing aid users and disusers

Group	Primary school	High school	Diploma/ Certificate	Degree	Post-graduate
HA users	2	12	8	3	10
HA disusers	3	20	11	0	1

Group	\$0-30k	\$30-60k	\$60-90k	\$90-120k	> \$120k
HA users	10	11	12	0	2
HA disusers	4	9	15	5	1

Group	In a Relationship	Not in a Relationship
HA users	24	11
HA disusers	20	15

Group	HAT Use	No HAT Use
HA users	20	15
HA disusers	10	25

Note. HA = Hearing Aid, HAT = Hearing Assistance Technology

3.2.2.1.1 Non-significant Variables

Results of the univariate ANOVA indicated there was no significant difference between age at HA fitting for the HA users and disusers ($p = .25$,) or self-rating of hearing severity ($p = .097$,). Results of the Chi square test revealed no significant differences between the groups in terms of: gender ($p = .053$), ethnicity (p

= .314), individuals in the household ($p = .215$), relationship status ($p = .458$) or income ($p = .084$).

3.2.2.1.2 Significant Variables

Results of the univariate ANOVA revealed significant differences between the groups. HA users were significantly older than HA disusers at the time of data collection ($p < .001$, $\eta^2 = .278$). These data are shown in Figure 5. Results of the Chi square test revealed that HA users were more likely to have a higher qualification ($p = .007$) and more likely to use HAT ($p = .029$). The reported education level of HA users and disusers as reported in the demographic questionnaire is displayed in Figure 6. The percentage of HA users and disusers who reported using HAT in the demographic questionnaire is displayed in Figure 7.

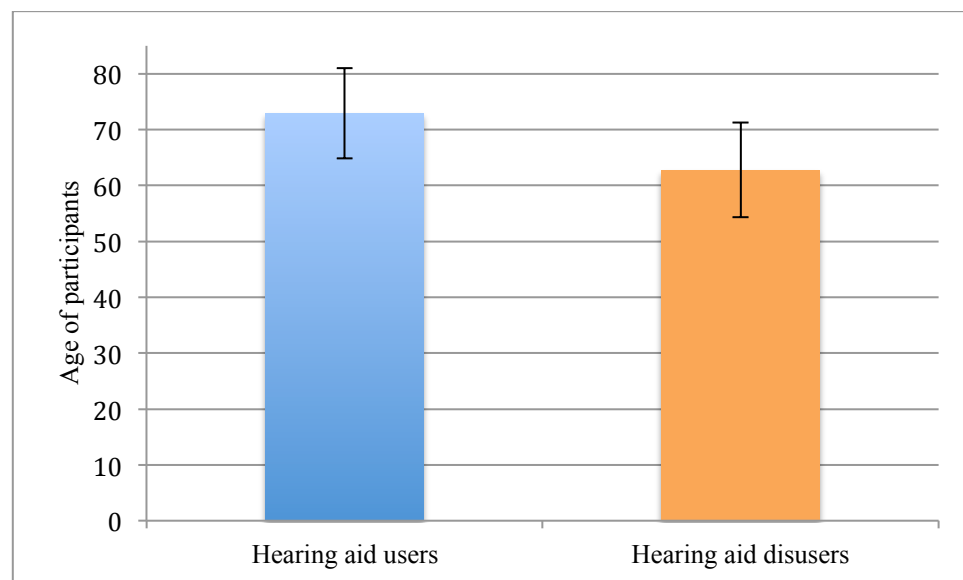


Figure 5. Mean ages and standard errors of hearing aid users and disusers at testing.

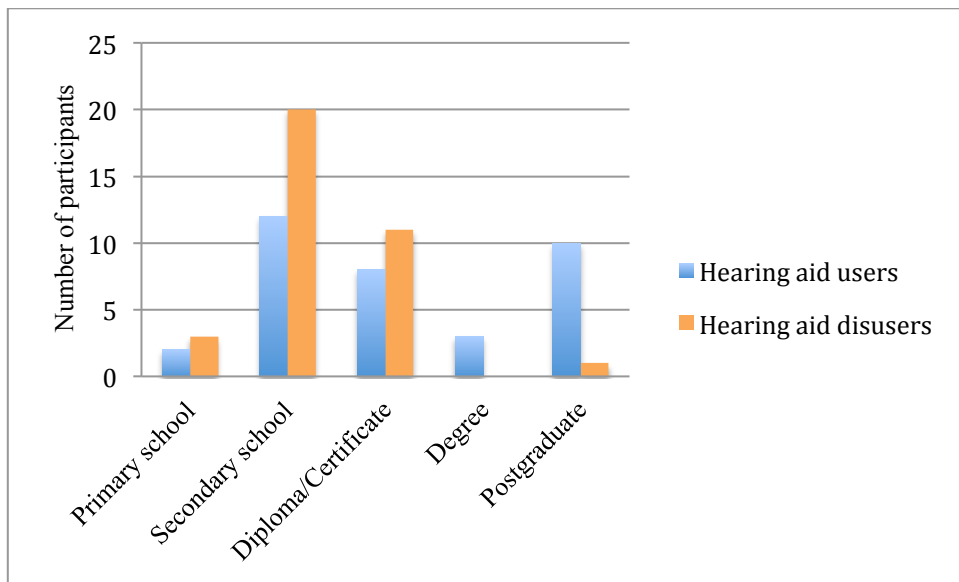


Figure 6. Level of education for hearing aid users and disusers as reported on the demographic questionnaire.

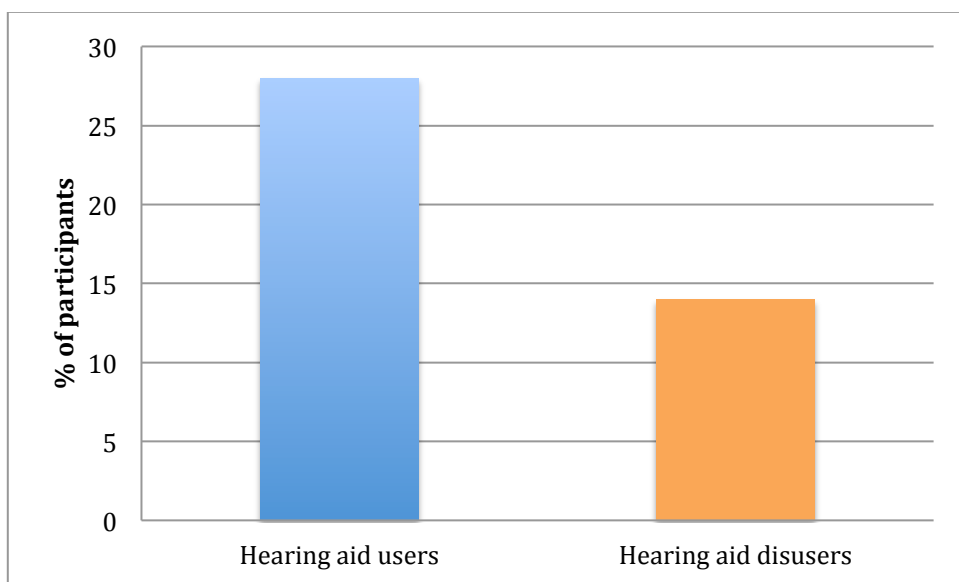


Figure 7. Percentage of hearing aid users and disusers who use hearing assistance technology (HAT).

3.2.2.1 Hearing Aid Variables

Hypothesis 2b looked specifically at: (i) HA satisfaction, (ii) HA subsidy, (iii) unilateral vs. bilateral fitting, (iv) self-efficacy, and (v) accepted need, (vi) consciousness (vii) HA outcomes and (viii) stages-of-change. HA satisfaction, past application for a HA subsidy, self-efficacy, accepted need, HA outcomes and stages-of-change were found to be significantly different between the groups.

Descriptive statistics for the continuous HA variables are shown in Table 5. A multivariate analysis of variance (MANOVA) was performed to determine between-group differences on the following HA variables: (1) HA satisfaction, (2) hearing self-efficacy, (3) managing self-efficacy, (4) accepted need, and (5) consciousness. The MANOVA revealed that participants in the two groups differed significantly on the set of variables, Wilks $\Lambda = .507$, $F(4,65) = 282.78$, $p < .001$. Box's $M = 88.083$, $p < .001$, indicating the equality of variance assumption had been violated, however this study had a relatively large sample size and the MANOVA was followed up with post hoc testing. The following multivariate effect size was calculated for the set of variables: $\eta^2 = 0.300$ and the observed power was $1 - \beta > .999$. Univariate analyses of variance (ANOVA) were used to determine which of the variables were contributing to the differences between the groups. With $\alpha_E = .05$, an $\alpha = .01$ was used for each univariate test. Levene's tests indicated that the assumption of homogeneity of variance was not violated for any of the univariate ANOVA tests.

The single hearing aid outcome variable (IOI-HA: International Outcome Inventory- Hearing Aids) and the single stage of change variable (URICA: University of Rhode Island Change Assessment – Readiness composite score) were submitted to

an independent t-test to determine if there were any between-group differences.

Levene's test for equality of variance was not violated. The results revealed a significant difference between the groups on the IOI-HA: $t(68) = 15.76, p < .001, d = 3.76$ and on the URICA: $t(68) = 4.68, p < .001, d = 1.12$.

Table 5. Descriptive statistics for the continuous hearing aid variables

Variables	Minimum	Maximum	Mean	SD
Hearing aid users				
HA satisfaction	3	9	6.53	1.76
Hearing self-efficacy	13	146	54.40	33.94
Managing self-efficacy	0	164	76.65	45.96
Accepted need	0	54	14.08	12.60
Consciousness	0	20	7.71	4.98
IOI-HA	22	32	27.88	2.33
URICA Readiness	2.67	8.83	6.98	1.36
Hearing aid disusers				
HA satisfaction	1	9	4.28	1.90
Hearing self-efficacy	11	141	94.75	28.25
Managing self-efficacy	10	155	101.68	26.03
Accepted need	16	70	53.83	16.56
Consciousness	0	18	8.60	3.84
IOI-HA	10	24	17.54	3.09
URICA Readiness	1.50	7.83	5.31	1.61

Note. HA = Hearing Aid, IOI-HA = International Outcome Inventory for Hearing Aid, URICA = University of Rhode Island Change Assessment.

Frequency counts for the categorical HA variables are shown in Table 6. Chi square tests were used to test for significant differences between the groups for bilateral HA fittings and application for a HA subsidy.

Table 6. Frequency counts for categorical hearing aid variables

Group	Bilateral Fitting	Unilateral Fitting
Hearing aid users	29	6
Hearing aid disusers	28	7
	Applied for Subsidy	Did not Apply for Subsidy
Hearing aid users	28	6
Hearing aid disusers	12	23

3.2.2.1.1 Non-significant Variables

The univariate ANOVA revealed no significant differences between the HA users and disusers on the consciousness scale of the HAQ ($p = .408$, $\eta^2 = .010$). The Chi square test revealed no significant difference between the HA users and disusers in terms of bilateral or unilateral HA fitting ($\chi^2 = .094$, $p = .759$).

3.2.2.1.2 Significant Variables

Univariate ANOVA revealed that HA users were significantly more satisfied with their HAs than HA disusers ($p < .001$, $\eta^2 = .279$). These data are shown in Figure 8. HA disusers exhibited greater self-efficacy in both hearing ($p < .001$, $\eta^2 = .300$) and managing ($p = .007$, $\eta^2 = .104$) compared to the HA users. These data are shown in

Figure 9. HA disusers exhibited lower accepted need for change than HA users ($p < .001$, $\eta^2 = .652$). These data are shown in Figure 10. The Chi square test did reveal that the hearing users were more likely to have applied for a HA subsidy ($\chi^2 = 16.34$, $p < .001$). These data are displayed in Figure 11. HA users also exhibited significantly higher IOI-HA scores ($p < .001$, $\eta^2 = .785$), and significantly higher Readiness composite scores on the URICA ($p < .001$, $\eta^2 = .244$) than the disusers. These data are shown in Figure 12 and 13.

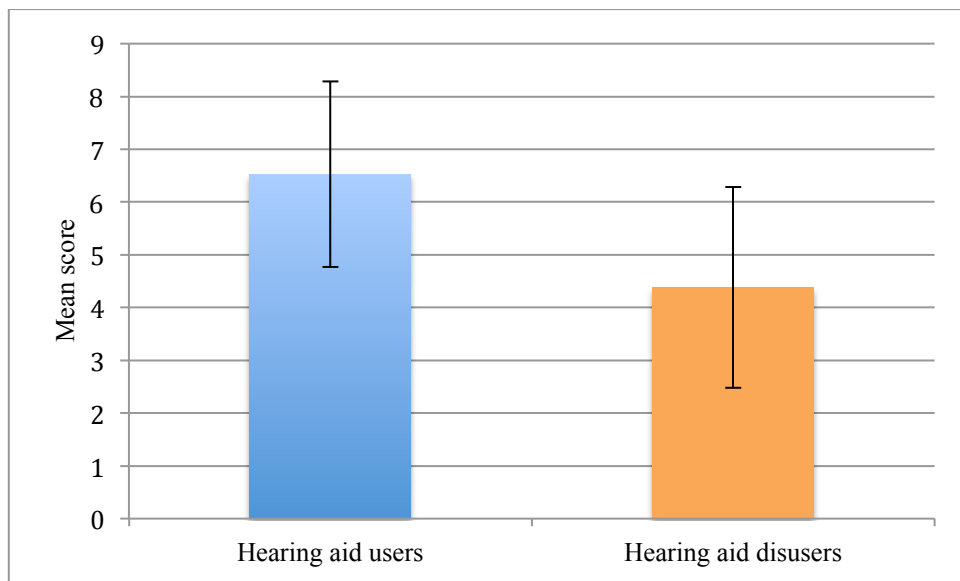


Figure 8. Mean scores and standard errors for hearing aid satisfaction for hearing aid users and disusers.

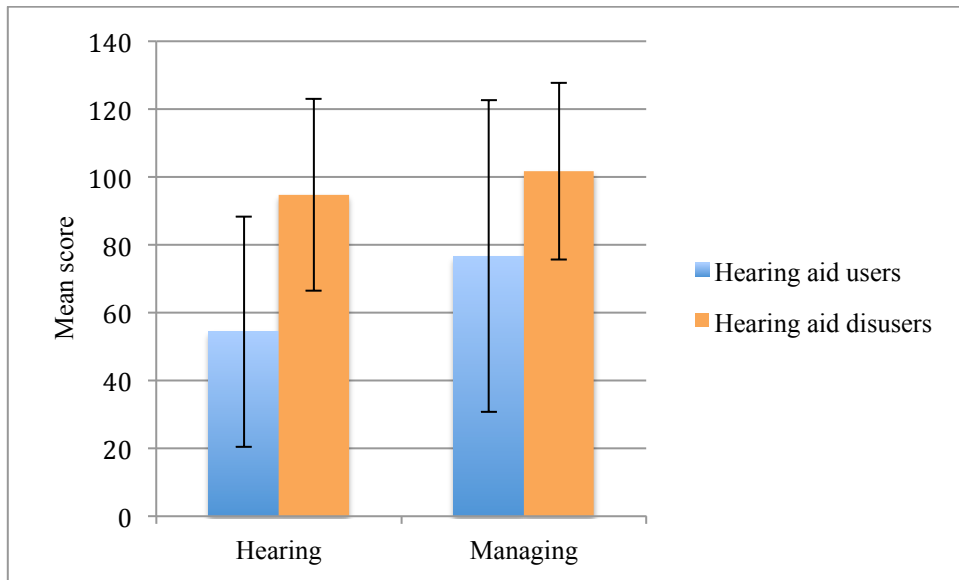


Figure 9. Mean scores and standard errors for self-efficacy for hearing and managing for hearing aid users and disusers.

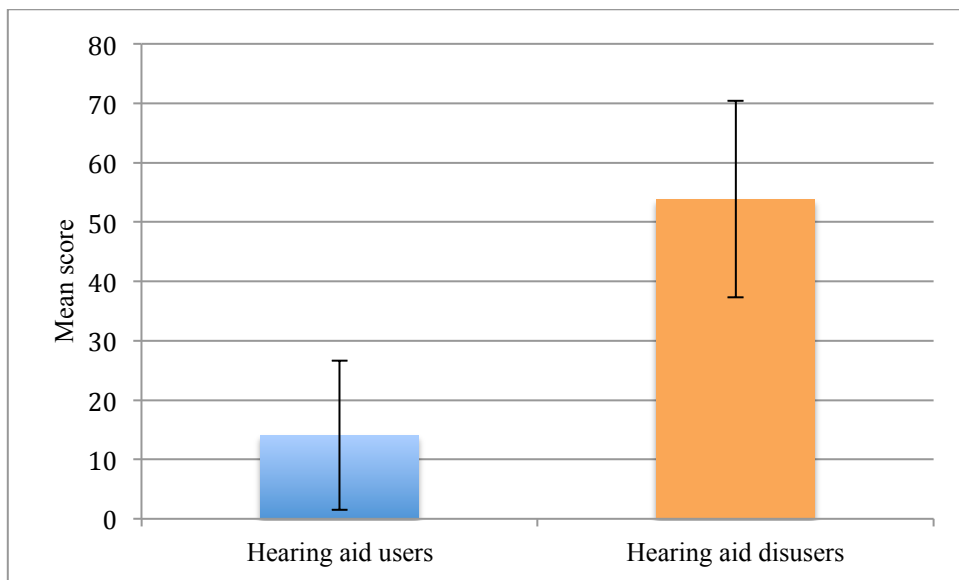


Figure 10. Mean scores and standard error for accepted need on the Hearing Aid Questionnaire (HAQ) for hearing aid users and disusers.

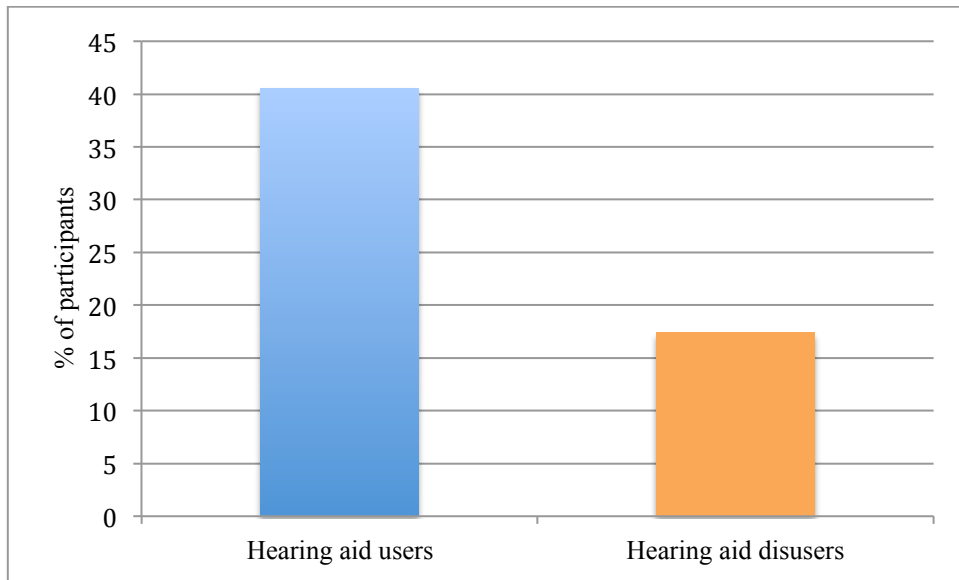


Figure 11. Percentage of hearing aid users and disusers who applied for a hearing aid subsidy.

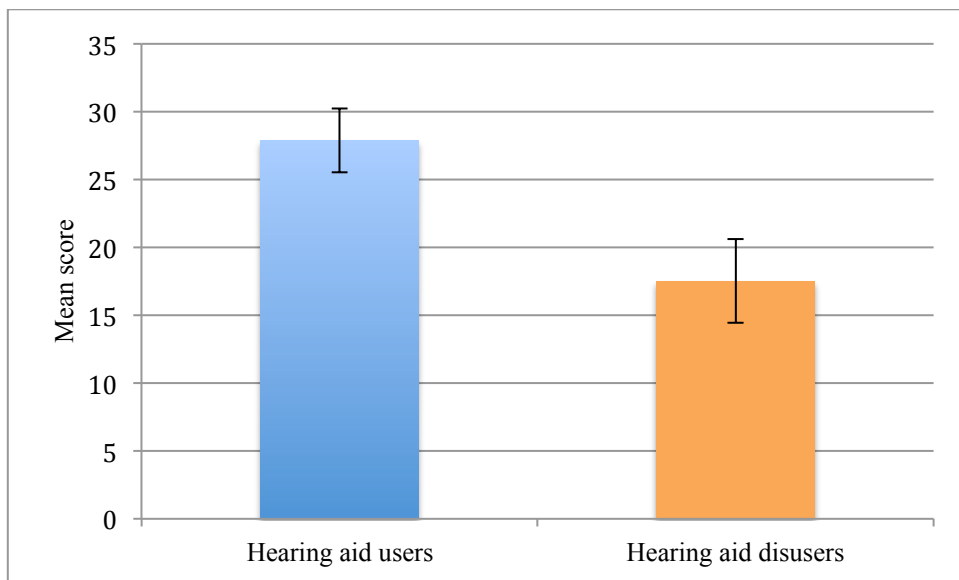


Figure 12. Mean scores and standard errors on the International Outcome Inventory - Hearing Aids (IOI-HA) for the hearing aid users and disusers.

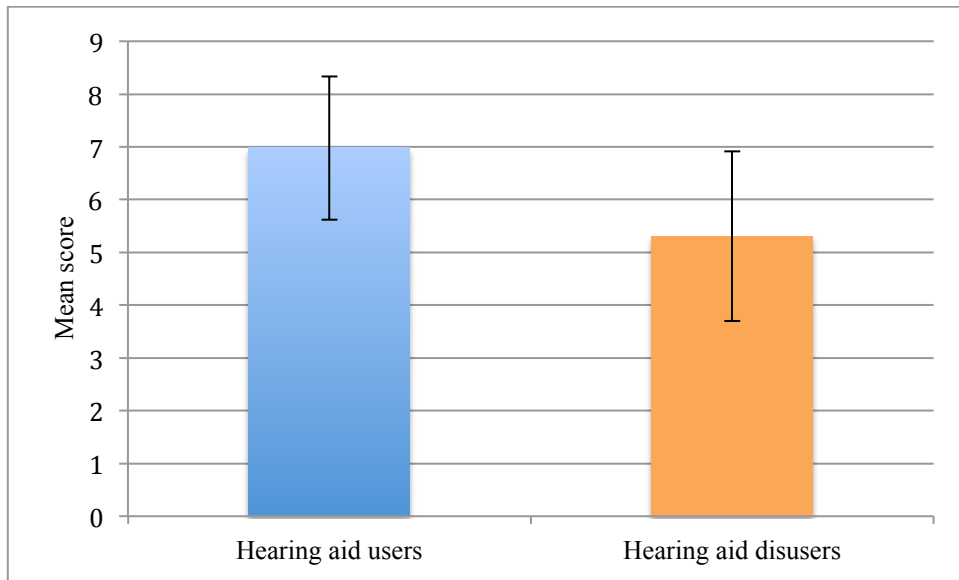


Figure 13. Mean scores and standard errors on the University of Rhode Island Change Assessment (URICA) for the hearing aid users and disusers.

3.2.3 Environmental Factors

Hypothesis 3 stated: There will be significant environmental differences between participants in the HA use and HA disuse groups. Specifically: (a) environmental influence and (b) follow-up support. This hypothesis was fully supported with both variables found to be significantly different between the groups.

Descriptive statistics for the Environmental factor variables on the HA Questionnaire (HAQ) are shown in Table 7. A multivariate analysis of variance (MANOVA) was performed to determine between-group differences on the following variables: (1) Social Assessment and (2) Follow-up Support. The MANOVA revealed that participants in the two groups differed significantly on the set of variables, Wilks $\Lambda = .340$, $F(5,64) = 24.80$, $p < .001$. Box's M could not be computed because there were fewer than 2 non-singular cell covariance matrices. The following multivariate effect size was calculated for the set of variables: $\eta^2 = 0.660$ and the observed power

was $1-\beta > .999$. Univariate analyses of variance (ANOVA) were used to determine which of the variables were contributing to the differences between the groups. With $\alpha_E = .05$, an $\alpha = .01$ was used for each univariate test. Levene's tests indicated that the assumption of homogeneity of variance was not violated for either of the univariate ANOVA tests.

Table 7. Descriptive statistics for the environmental factors on the Hearing Aid Questionnaire (HAQ)

Variable	Minimum	Maximum	Mean	SD
Hearing aid users				
Social Assessment	1	15	5.97	3.42
Follow-up Support	0	27	10.75	8.06
Hearing aid disusers				
Social Assessment	2	23	10.31	6.57
Follow-up Support	7	44	25.48	11.47

3.2.3.1 Non-significant Variables

There were no non-significant variables in these analyses.

3.2.3.2 Significant Variables

HA users had significantly lower follow-up support scores ($p < .001$, $\eta^2 = 0.363$) and social assessment scores ($p = .001$, $\eta^2 = 0.150$) than the HA disusers.

These data are shown in Figures 14 and 15.

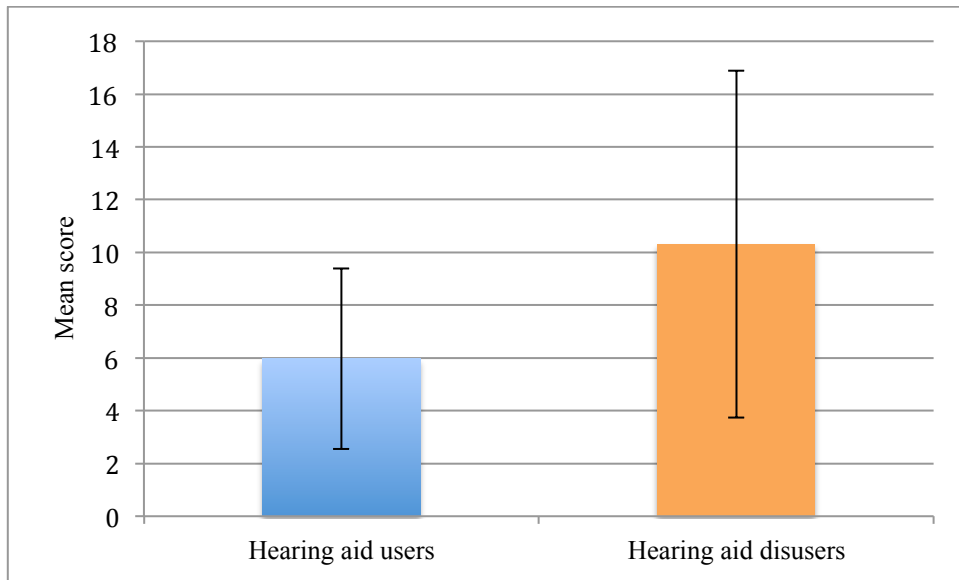


Figure 14. Mean scores and standard errors for Social Assessment for the hearing aid users and disusers.

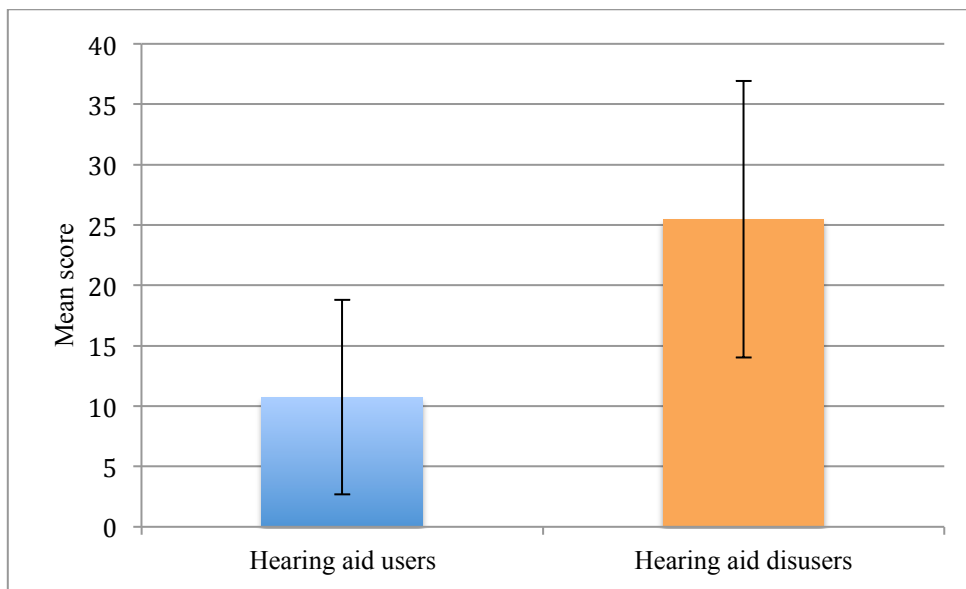


Figure 15. Mean scores and standard errors for Follow-up Support for the hearing aid users and disusers.

3.2.4 Activity Limitations and Participation Restrictions (AL/PR)

Hypothesis 4 stated: There will be significant AL/PR differences between participants in the HA use and HA disuse groups. Specifically on the (a) HHQ. This hypothesis was fully supported.

Descriptive statistics for the self-report questionnaire is shown in Table 8. The single hearing handicap questionnaire (HHQ: Hearing Handicap Questionnaire), was submitted to a univariate ANOVA. Levene's tests indicated that the assumption of homogeneity of variance was not violated for the univariate ANOVA test.

Table 8. Descriptive statistics for the self-report questionnaire variables (Hearing Handicap Questionnaire; HHQ)

Questionnaire	Minimum	Maximum	Mean	SD
Hearing aid users				
HHQ	20	60	37.40	8.26
Hearing aid disusers				
HHQ	10	57	29.91	8.55

3.2.4.1 Non-significant Variables

There were no non-significant variables in these analyses.

3.2.4.2 Significant Variables

HA users exhibited significantly more hearing handicap ($p < .001$, $\eta^2 = .169$),) than the disusers. These data are shown in Figures 16.

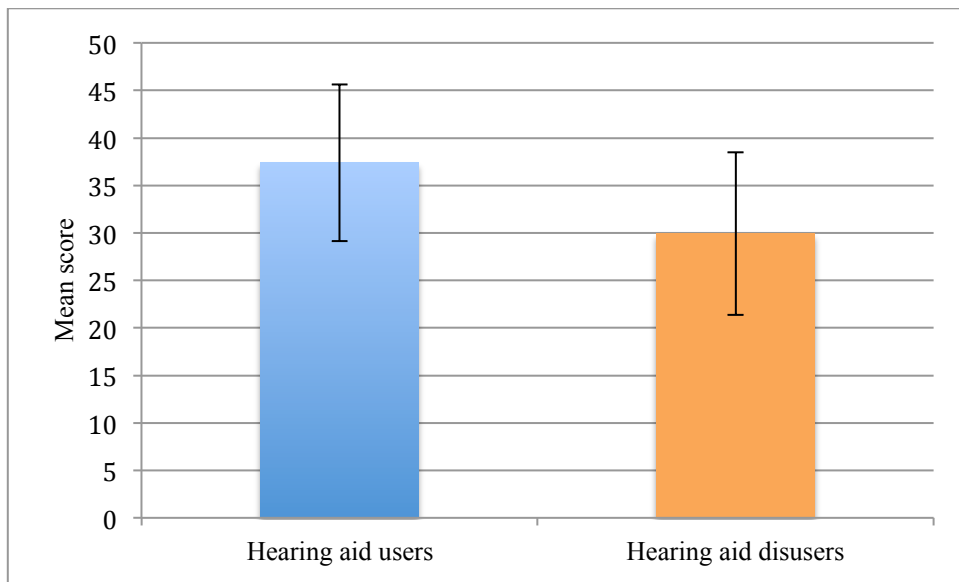


Figure 16. Mean scores and standard errors for the Hearing Handicap Questionnaire (HHQ) for the hearing aid users and disusers.

3.3 Discriminant Analysis

A discriminant analysis was performed to determine the significant variables that best classified the participants in terms of HA use. Box's test of equality of covariance matrices was non-significant, so the assumption was not violated. A step-wise method was used and four variables were entered into the equation. The discriminant equation is as follows (in order of importance): $D_i = -13.08 + .449 (\text{IOI-HA}) + .139 (\text{Social Assessment}) + .056 (\text{SNR loss}) + .044 (\text{HHQ})$. Using this equation, 93.7% of the original cases were correctly classified and 93.7% of the cross-validated cases were correctly classified. Cross validation is a process of assessing the accuracy of a model. If the proportion of the cross-validated cases correctly classified exceeds the proportional by chance accuracy, the discriminant ability of the model is supported. In this case, the proportional by chance accuracy was calculated to be 50%. Thus, the discriminant ability of this model is supported.

3.4 Summary of Findings

In summary, the participants in this sample who are current HA users did not differ from HA disusers in terms of their BEPTA or WEPTA. Nor did the groups differ for finger dexterity. Most demographic variables did not differentiate HA users from disusers: age at fitting, gender, ethnicity, income, number of individuals in the household, relationship status or self-rating of hearing ability. There was no difference between the groups based on whether or not the HA fitting was unilateral or bilateral. Nor did the groups differ with respect to their attitudes towards hearing impairment or HAs as measured by the HAQ.

The participants in this sample did differ on the following body function variables: HA disusers exhibited less difficulty understanding speech in background noise and higher acceptance of noise than HA users. Furthermore, fewer HA users passed the MoCA and more disusers passed the MoCA than would be expected by chance.

The participants in this sample also differed on several personal factor variables. Three demographic variables were found to be different for HA users and disusers: HA users were more likely to be older at testing, report higher levels of education than HA disusers and use HAT. Additionally, the groups differed in terms of HA-related variables. HA users were more satisfaction with their HAs compared with HA disusers. HA users were also more likely to have applied for a HA subsidy, reported more acknowledged need for HAs, reported better HA outcomes on the IOI-

HA and have higher levels of readiness for change than the HA disusers. HA users were also found to have less confidence in their ability to manage various listening situations compared to hearing aid disusers.

Both environmental variables were found to be significant as HA users reported receiving more follow-up support after HA fitting, and reported less environmental influence on their experience of hearing impairment than HA disusers. Additionally, HA users reported less hearing related AL/PR compared to HA disusers.

The results of the discriminant analysis indicated that a complex set of variables best classified participants in this sample according to HA use: HA outcomes, perceived environmental influence on their experience of hearing impairment, ability to understand speech in noise, and perceived hearing handicap.

Chapter Four: Discussion

This chapter discusses the findings of this study. The present study aimed to investigate the relationship of body functions, personal factors, environmental factors, and AL/PR on HA disuse in New Zealand/Aotearoa. Body function variables were obtained via audiometric data through four audiometric variables: better-ear pure-tone average (BEPTA), worse-ear pure-tone average (WEPTA), signal-to-noise ratio (SNR) loss and acceptance of noise. Non-audiometric, body function variables were obtained using the Montreal Cognitive Assessment - MoCA and Purdue pegboard test. Personal factors and environmental factors related to the participants were obtained via questionnaires: demographic questionnaire, International Outcomes Inventory – HAs (IOI-HA), Hearing Aid Questionnaire (HAQ), Self-efficacy for Situational Management Questionnaire (SESMQ) and University of Rhode Island Change Assessment – modified (URICA). Hearing related AL/PR was obtained via the Hearing Handicap Questionnaire (HHQ). Pearson product-moment correlations were used to determine the presence of relationships between variables. Analyses of variance were used to determine the differences between HA users and disusers. Finally, discriminant analyses were used to determine the variables that best classified the participants in terms of HA use.

4.1 Relationship Between Hearing Aid Disuse and Body Functions

4.1.1 Audiometric Variables

Hypothesis 1a stated that there would be significant audiometric variable differences between the HA use and disuse group, specifically: (i) BEPTA, (ii)

WEPTA, (iii) SNR loss and (iv) acceptance of noise. This study found that BEPTA and WEPTA were not significantly different between the two groups, thus not supporting part a and b of the hypothesis. SNR loss and acceptance of noise was significantly different between the groups, thus supporting part (iii) and (iv) of the hypothesis.

4.1.1.1 Significant Variables

4.1.1.1.1 Signal-to-noise ratio (SNR) loss

For participants in this study, higher degrees of SNR loss as measured by the QuickSIN test, was associated with HA use, thus supporting part (iii) of the hypothesis. Specifically, HA users exhibited more difficulty understanding speech in background noise. These results support findings by Robertson, Kelly-Campbell and Wark (2012) who also found that participants with higher degrees of SNR loss as measured by the QuickSIN, had better HA outcomes than participants who had lower degrees of SNR loss. In this study, HA users had a mean SNR loss of 12dB compared to HA disusers who had a mean SNR loss of 2.7dB. The QuickSIN manual suggests that for individuals with a moderate SNR loss (7-15 dB), benefit can be obtained with directional microphones or array microphones and for individuals with severe SNR loss (greater than 15dB), maximum SNR improvement is required and an FM system should be considered (Etymotic Research, 2001). Therefore it is possible that those who experience the most difficulty in background noise experience more benefit from directional microphones and array microphones provided by HAs, resulting in continued HA use. It is also likely that HA disusers do fairly well in noisy environments and therefore do not experience the same benefits from wearing HAs. Not to mention, HAs may even make listening in background noise worse for hearing

aid disusers. More research is required in this area but it appears that speech in noise tests can differentiate hearing aid users from hearing aid disusers.

4.1.1.1.2 Acceptance of noise

In this study, HA disusers had a higher acceptance of noise as measured by the ANL test, than HA users, thus supporting part (iv) of the hypothesis. However, this finding contradicts findings from the developers of the ANL test (Nabelek, Freyaldenhoven, Tampas, Burchfield, & Muenchen, 2006). These developers stated that full-time HA users have significantly lower unaided ANL scores than part-time users or non-users. In this current study, it was found that HA disusers had an average score of four and HA users had an average score of seven. As reported previously, individuals who have “low” ANLs (< 7 dB) are generally said to be successful HA wearers (full-time HA users), whereas individuals who have “high” ANLs (> 13 dB) are said to be unsuccessful HA wearers (part-time HA users or non-users). The term “mid” is reserved for ANL scores from 7 to 13 dB and these individuals can either be classified as successful or unsuccessful HA wearers (Nabelek et al., 2006). HA disusers in this study are therefore classified as having “low” ANLs, indicating that they should be successful HA wearers. Whereas the HA users are classified as having “mid” ANLs, suggesting that they could be either successful or unsuccessful HA users.

Interestingly, the findings from this study are consistent with findings from Walravens, Keidser, Hartley and Hickson (2014) who also found that unsuccessful HA users (part-time HA users and disusers) had statistically significant lower ANL values than successful HA users (full-time HA users), thus completely contradicting

findings by Nabelek et al. (2006). Furthermore, Freyaldenhoven, Nabelek and Tampas (2008) and Olsen, Nielsen, Lantz and Brännström (2012a; b) also reported that the ANL test generates unreliable results that do not predict HA use. Nevertheless, the results of this study suggest that the ANL test can differentiate HA users from disusers, even if it is not how the developers of the ANL test intended.

It is unknown why studies in the literature on the ANL test are so variable. It is possible that the level of HA experience across studies may impact on an individuals ANL score. The developers of the ANL test focused on individuals with three years or less HA experience, whereas participants in this study and the study by Walravens et al. (2014) included participants with a longer history of HA use. It is also possible that different versions of the ANL test being utilized and a large inter- and intra- participant variability across studies may account for some of this variability. Furthermore, data collection across studies tends to be inconsistent which may also contribute to the disparate findings.

4.1.1.2 Non-significant Variables

No significant relationship was present between the severity of hearing impairment and HA disuse. Therefore, part (i) and (ii) of the hypothesis was not supported by the results of this study. This finding is consistent with findings from Hickson et al. (2014). Their study also found no significant relationship between hearing sensitivity for successful and unsuccessful HA users. Furthermore, the severity of hearing impairment in isolation has not been found to be a good predictor of help-seeking and HA adoption (Duijvestijn et al., 2003; Kochkin, 2009), therefore it is proposed that hearing impairment is not a good predictor of rehabilitation

outcomes. As mentioned previously, pure-tone audiometry does not provide information about how an individual experiences their hearing impairment in everyday life (Demorest et al., 2011; Ventry & Weinstein; 1982). As a result, the audiogram alone is not a good predictor of hearing related AL/PR an individual may face. Nor does it appear to be a good predictor of rehabilitation for those AL/PR. Future research is still required in this area to fully rule out a relationship with hearing impairment and HA disuse.

4.1.2 Non-audiometric factors

Hypothesis 1b stated that there would be significant non-audiometric body function differences between the HA use and disuse group, specifically (i) finger dexterity and (ii) cognition. This study found that dexterity as measured by the Purdue pegboard test was not significantly different between the two groups, thus not supporting part a of the hypothesis. Cognition scores as measured by the MoCA were significantly different between the groups, thus supporting part b of the hypothesis.

4.1.2.1 Significant Variables

4.1.2.1.1 Cognition

In this study, the Chi square test indicated that fewer HA users passed the MoCA and more disusers passed the MoCA than would be expected by chance, thus part (ii) of this hypothesis was supported. This finding indicates that HA users were less likely to pass a cognitive screen than HA disusers. Very few studies are available that investigate this relationship between cognition and HA use. However, the findings from this study are inconsistent with Lupsakko et al. (2005) who examined

HA use in a population aged > 75 years (mean age = 81.3) in Finland. That study found that HA disusers performed poorer on the MMSE compared to part-time users and full-time users. One major difference between the two studies is that the population in the current study was a lot younger. As mentioned previously, Hickson et al. (2014) conducted a retrospective study on individuals aged 60 years (mean age = 73) and older in Australia. That study found that unsuccessful HA users performed worse on memory and reasoning/judgements subtests of the Cognistat. In the current study it was also found that the memory/delayed recall task was overall more challenging for the participants. No explanation has been given by either author about why successful HA users performed better on the cognitive screens than unsuccessful users. While the data in this study did not support these previous studies, it is important to keep in mind that the vast majority of the participants in the current study (78.57%) passed the MoCA. Therefore it is possible that there were ceiling effects.

4.1.2.2 Non-significant Variables

Finger dexterity was not found to be different for HA users and disusers. Thus part (i) of this hypothesis was not supported. Statistical analysis revealed no significant differences between the groups on any dexterity variable. Currently, there is mixed data in the literature regarding the relationship between dexterity and HA use. However, the findings from this study are consistent with Hickson et al. (2014) findings, as they too found no difference in finger dexterity for successful and unsuccessful HA users. As discussed in Chapter One, Bertoli et al. (2009) reported that difficulties handling a HA were associated with non-regular use of the device. There is one major difference between the Bertoli et al. (2009) study and the current study, which may have contributed to this discrepancy. Bertoli et al. (2009) asked in a

questionnaire whether or not participants had difficulties managing their HAs (e.g. volume control), whereas the current study and the study by Hickson et al. (2014) measured dexterity through objective tests such as the Purdue pegboard test and the grooved pegboard test, respectively. Therefore there are two possible explanations for these differing results: 1) It is possible that HA disusers subjectively report their dexterity to be worse than it objectively is and 2) These tests are not capturing the dexterity issues faced by hearing impaired participants as these tests were designed for occupational purposes. Therefore these dexterity tests may not accurately assess the dexterity issues experienced by adults when handling HAs.

4.2 Relationship Between Hearing Aid Disuse and Personal Factors

4.2.1 Demographic Variables

Hypothesis 2a stated that there would be significant demographic differences between the HA use and disuse group. This study found that age at testing, education, and use of HAT were significantly different between the groups, thus supporting parts (i), (vii) and (x) of the hypothesis. Age at fitting, gender, ethnicity, income, individuals in household, relationship status, and self-rating of hearing severity were not significantly different for the HA users and disusers, thus not supporting parts and (ii), (iii), (iv), (v), (vi)(viii) and (ix) of the hypothesis.

4.2.1.1 Significant Variables

4.2.1.1.1 Age at testing

In this study, participants who were older, were more likely to be HA users than disusers. Thus the results from this study support part a of the hypothesis. This finding contradicts findings by Hickson et al. (2014) who reported that unsuccessful HA users were older than successful HA users. Differences may stem from the larger age range in the current study compared to the Hickson et al. (2014) study. The criteria used to define HA use and successful HA use were also different across the two studies. Recall that in this study HA use was defined as > 1 hour of daily HA use compared to the study by Hickson et al. (2014) who defined successful HA use as “a minimum of one hour of daily HA use and at least moderate benefit from HAs in the situation the individual most wanted to hear better”. Other studies in the literature have found no relationship between age and HA use (Chang, Tseng, Chao, Hsu & Liu, 2008; Lupsakko et al., 2005; Solheim et al., 2012). Therefore there is no consensus on how age affects HA use. It is possible that HA use is like a stages-of-change model in that it is cyclical. Individuals may move in and out of stages, perhaps moving into relapse (HA disuse) and then back into action/maintenance (HA use) and this may show up as a difference in the ages of participants at testing, but not at first HA fit.

4.2.1.1.2 Education

In this study, HA users were more likely to report higher levels of education, than disusers, thus supporting part (vii) of this hypothesis. This finding contradicts findings from overseas studies that have shown no relationship between education and HA disuse, particularly studies by Hickson et al. (2014) and Öberg et al. (2012).

These disagreements may be accounted for by the different methods and populations used in this current study and in the study by Hickson et al. (2014). The current study asked participants to select the highest level of education completed out of: some primary school, completed primary school, completed high school, completed an undergraduate diploma or certificate, completed an undergraduate degree and completed a postgraduate degree or certificate at university. However, Hickson et al. (2014) divided participants into three groups: primary school, secondary school and tertiary education. Therefore the different methods used for splitting participants into education groups may be responsible for the differing results. In addition, participants in the current study had lower levels of education than participants in the Hickson et al. (2014) study. Furthermore, contradictions from the current study and the study by Öberg et al. (2012) may have occurred because Öberg et al. (2012) may not have had enough statistical power to detect a significant difference for education as there were only 15 HA disusers in that study.

4.2.1.1.3 Hearing assistance technology

Participants in this study who used HATs were more likely to be HA users than disusers. Thus the results from this study support part (x) of this hypothesis. Therefore it appears that individuals who use HAs are the same individuals that use HAT. There is no data available to support or refute this relationship. However these findings are somewhat consistent with previous findings by Kelly-Campbell and Lessoway (2015) who found that all HA owners (users and disusers) used at least one HAT. This is in contrast to the non-owners in that study who reported not using HAT. Similarly, Williger and Lang (2014) reported that 84% HA owners in their study used

a HAT device in the last two years. Therefore it appears that similar processes may be occurring for HA and HAT ownership and use.

4.2.1.2 Non- significant Variables

No other demographic variables differentiated HA users from HA disusers. Specifically, the following demographic variables did not distinguish between the two groups: age at HA fitting, gender, ethnicity, relationship status, individuals in household, income and self-rating of hearing severity. As noted previously, the relationship between demographic variables and HA use/disuse is complex, and this complexity is demonstrated in the mixed data reported in various overseas studies. The present study found no difference between the HA use and disuse groups for age at HA fitting. Therefore the effect of age at HA fitting and HA disuse remains unclear.

Demographic factors such as: female sex, different ethnicities, number of individuals in a household and higher levels of self-reported hearing difficulties have been shown to have a positive relationship with HA use (Bertoli et al., 2009; Cox et al., 2007; Hickson et al., 2014; Öberg et al., 2012; Takahashi et al., 2007), although not all the data from these studies are supportive of these relationships. Solheim et al. (2012) reported no differences in marital status for HA users and disusers, thus supporting the results from this study. Therefore continued HA use does not appear to be different for individuals that cope with the effects of hearing impairment alone or with the support of a significant other.

As previously mentioned, sample demographics may have had an impact on whether or not a significant relationship was found. This study had more males (23) than females (11) in the HA use group and more females (20) than males (15) in the HA disuse group. Gender was close to being statistically significant ($p = 0.053$), therefore it may be ascertained that with an equal number of males and females in each group, gender as a variable may have been significant. To date, there has been very little research examining the differences between females and males and their use of HAs. The underlying reasons for HA disuse may differ between females and males, and a consideration of such factors could potentially increase HA use.

Furthermore, the self-identified ethnicity for 69 participants was New Zealander/European and one participant in the HA use group self-identified as Māori. The New Zealand population is made up of: 70% European, 14% Māori, 11% Asian, 7% Pacific individuals, 1% Middle Eastern/Latin American/African and 2% “Other” ethnicity (Statistics New Zealand, 2013). Therefore a sample more reflective of the New Zealand population is required to determine whether or not ethnicity plays a role in HA use/disuse.

This study did not find that income differentiated HA users from HA disusers. This contradicts findings by Lupsakko et al. (2005) who found that disusers had approximately half the median income compared to part-time and full-time users. The current service delivery model in New Zealand includes a government subsidy of \$511.11 per ear for any individual who needs HAs. It is therefore possible to receive a pair of basic HAs for this price. Consequently it is plausible that differences in healthcare delivery systems account for the differences found in these two studies.

Furthermore, it is unknown why this study did not find a relationship between self-reported hearing difficulties and HA use like Hickson et al. (2014) and Takahashi et al. (2014). Once again it may come down to the different methods of obtaining self-ratings of severity. In the current study, participants were asked to rate on a scale from 1 to 10 the severity of their hearing problems. Hickson et al. (2014) and Takahashi et al. (2007) used questionnaires to assess self-ratings of severity. In the Hickson et al. (2014) study, self-reported hearing difficulties were also evaluated before the participants acquired HAs. Participants who said they had more hearing difficulties in everyday life prior to obtaining HAs were more likely to become successful HA users. This was measured with the HHQ and self-assessment of communication. Therefore differences maybe observed in self-reported hearing difficulties prior to HA fittings rather than post HA fittings. Takahashi et al. (2007) used the Glasgow HA Benefit Profile (GHABP) to measure self-ratings of severity. Initial disability scores were derived from the subset of listening circumstances and it was proposed that disusers elected not to use their HAs because they were experiencing less difficulty. Therefore it maybe that the severity of hearing impairment as measured by one question compared to a questionnaire on situational dependent difficulties results in different self-perceived hearing difficulties. This notion is further supported by the significant findings found in this study with the HHQ, which will be discussed further in section 4.4.

4.2.2 Hearing Aid Variables

Hypothesis 2b stated that there would be significant HA related differences between the HA use and disuse group. This study found that HA satisfaction, HA

subsidy, self-efficacy, accepted need, HA outcomes and stages-of-change were significantly different between the groups, thus supporting parts (i), (ii), (iii) (v), (vii) and (viii) of the hypothesis. Consciousness, unilateral vs bilateral fittings and age at HA fitting were not significantly different for HA users and disusers.

4.2.2.1 Significant Variables

4.2.2.1.1 Hearing aid satisfaction

Participants in this study who were satisfied with their HAs were more likely to be HA users than disusers, thus supporting part (i) of this hypothesis. This finding supports data from overseas studies that have shown a positive relationship between satisfaction and HA use, particularly studies by Kaplan-Neeman et al. (2012), Uriarte et al. (2005) and Bertoli et al. (2009). Kaplan-Neeman et al. (2012) found a moderately significant correlation between hours of HA use per day and satisfaction ratings on the Positive Effects subscale of the SADL, with longer hours of HA use being related to higher satisfaction ratings. These findings are also supported by a study by Uriarte et al. (2005) who found increased HA use was related to greater satisfaction. In a New Zealand study by Jerram and Purdy (2001) it was also found that individuals who wore their HAs more reported higher levels of satisfaction. Similarly, Bertoli et al. (2009) found that individuals, who reported being dissatisfied with their HAs, were more likely to be HA disusers or occasional users. Therefore satisfaction with HAs appears to play an important role in continued HA use.

4.2.2.1.2 Hearing aid subsidy

For participants in this study, it was found that individuals who had applied for a HA subsidy were more likely to be HA users, thus supporting part (ii) of this hypothesis. These findings are similar to findings by Laplante-Levesque, Hickson and Worrall (2011) who found that prior application for a government HA subsidy was related to the likelihood a person would choose to obtain HAs over participating in a communication program. Similarly, Laplante-Levesque, Hickson and Worrall (2012) found that previous application for a government subsidy was related to the likelihood that an individual would obtain a HA over no intervention. These findings contradict findings from a study in Wales by Stephens et al. (2001). In that study, HAs were either provided by the National Health Service (NHS) or paid for privately. No differences in funding type were found for HA users and disusers in that study. Interestingly, Stephens et al. (2001) reported that 80 to 85 per cent of HAs possessed in the United Kingdom are obtained free of charge from the NHS. As previously mentioned, the current service delivery model in New Zealand includes a government subsidy of \$511.11 per ear for any individual who needs HAs. It is therefore plausible that the different levels of funding available in each country account for some of the differences found in these studies. However, overall it appears that there is some support in the literature that applying for a government subsidy is related to decisions about HA intervention.

4.2.2.1.3 Self-efficacy

The results of this study showed that HA disusers rate themselves higher on both the hearing and managing subscales of the SESMQ, thus supporting part (iii) of this hypothesis. As previously mentioned, perceived self-efficacy is not thought of as

a measure of skill, but of an individual's belief about what they can do under different sets of conditions with whatever skills they possess. These results contradict findings by Hickson et al. (2014) and West and Smith (2007) who found that successful HA users had higher self-efficacy as measured by the MARS-HA, than unsuccessful HA users. These findings most likely contradict the results from the Hickson et al. (2014) study and West and Smith (2007) study as the questionnaires were measuring different aspects of self-efficacy. The studies by Hickson et al. (2014) and West and Smith (2007) looked specifically at HA self-efficacy, indicating that HA users are more confident in their abilities to manage their HAs than HA disusers, whereas, the results from this study suggest that HA disusers are more confident in their abilities to listen and manage different listening situations. It appears that HA disusers are more likely to believe that they have the skills necessary to carry out actions, effectively problem solve and be adaptive in their coping in different listening environments without relying on HAs.

4.2.2.1.4 Accepted need

In the present study, a relationship between accepted need as measured by the HAQ, was related to HA use. HA users reported more acknowledged need for HAs than disusers, thus supporting part (v) of the hypothesis. This is in agreement with findings by Solheim et al. (2012) who also found that the acceptance of hearing loss and the subjective assessment of the need for a HA were related to HA use. Bertoli et al. (2009) also found that 23.9% of occasional users or disusers reported that they had no perceived need for their HAs. Therefore an individual's accepted need is likely, at least in part, to determine the long-term use of HAs. If an individual does not believe

they need their HA or if they believe that the benefits of using HAs do not outweigh the inconveniences of wearing HAs, then they will not continue to use them.

4.2.2.1.5 Hearing aid outcomes

This study found that scores on the IOI-HA differentiated HA users from disusers, thus supporting part (vii) of this hypothesis. HA users reported better HA outcomes on the IOI-HA than disusers. This is not surprising considering the IOI-HA consists of the following concepts: 1) HA daily use, 2) benefit, 3) residual activity limitations, 4) satisfaction, 5) residual participation restrictions, 6) impact on others, and 7) quality of life; this study has already established: daily use, AL/PR and satisfaction differentiate HA users from disusers and the literature reports that poor perceived benefit is often provided as a reason for HA disuse (Bertoli et al., 2009; Hickson et al., 2014; Solheim et al., 2012).

4.2.2.1.6 Stages-of-change

This study found that readiness to change as measured by the URICA differentiated HA users from disusers, thus supporting part (viii) of this hypothesis. HA users had higher levels of readiness to change than disusers. While there are no other data to shed more light on this relationship with HA disuse, it does support similar findings by Laplante-Lévesque et al. (2013) who reported that an individual with a more advanced stage of change, would be more likely to take up HAs or a communication program and be more likely to report successful outcomes. Therefore it is likely that individuals who are at the action (healthy behaviour acquisition) and maintenance (sustained healthy behaviour and relapse prevention) stages are more likely to use their HAs. It is also probable that HA use is like a cyclical stages-of-

change model. Individuals may move in and out of stages, perhaps moving into relapse (HA disuse) and then back into action/maintenance (HA use). Future research in this area is needed to replicate the relationship between readiness to change and HA use/disuse.

4.2.2.2 Non-significant Variables

No other HA variables differentiated HA users from HA disusers. Specifically, the following variables did not distinguish between the two groups: consciousness and unilateral vs bilateral fittings.

Like Solheim et al. (2012), no relationship was found for consciousness and HA use in this study. Consciousness was defined as the participant's attitudes towards hearing impairment and HAs. Consciousness was measured through the following questions: 1) Pressure from relatives is the main reason for providing HAs and 2) I am well informed about the cause of my hearing loss. It is possible that the HAQ may not be sensitive enough to accurately capture this construct of consciousness. It is assumed that had the questionnaire been more specific, these studies would have obtained different results. Particularly as other studies in the literature have found that a positive attitude to HAs and hearing impairment is related to successful HA use (Hickson et al., 2014, Wilson & Stephens, 2003)

The current study also found no difference in HA use/disuse for unilateral and bilateral HA fittings. This finding contradicts previous research by Bertoli et al. (2009) who reported that individuals fitted with HAs bilaterally had a higher incidence of HA use. In that study by Bertoli et al. (2009), 39% of the participants

owned a HA for one ear compared to this study in which only 18.6% of participants were fitted unilaterally. Thus the relatively small number of unilateral HA fittings in this study may account for this non-significant finding.

4.3 Relationship Between Hearing Aid Disuse and Environmental Factors

Hypothesis 3 stated that there would be significant environmental differences between the HA use and disuse group. This study found that environmental influence and follow up support were significantly different between the groups, thus supporting parts (a) and (b) of the hypothesis.

4.3.1 Significant Variables

4.3.1.1 Environmental influence

This study found that environmental influence differentiated HA users from disusers, thus supporting part (a) of this hypothesis. HA users in this study reported less environmental influence (social assessment) on their experience of hearing impairment than disusers, as measured by the HAQ. Our findings contradict findings by Hickson et al. (2014) who report that individuals who had greater positive support from significant others were more likely to be successful HA users. These differences most likely stem from how HA use/successful HA use was defined and how the information on environmental influence was obtained in the two studies. In this study HA use was defined as > 1 hour of daily HA use compared to Hickson et al. (2014) study who defined successful HA use as “a minimum of one hour of daily HA use and at least a moderate benefit from HAs in the situation the individual most wanted to hear better”. Furthermore, the current study used the HAQ to assess environmental influence. The HAQ uses the following two questions: (1) It has not been socially

embarrassing for me to use a HA among other people and (2) My impression is that hearing-impaired individuals of my age are satisfied with their HAs. Whereas the Hickson et al. (2014) study used the attitude to HA questionnaire (modified version) which is a 23 item questionnaire looking at perceived benefits, positive support from significant others, perceived stigma, negative support from significant others, and ageism.

Interestingly, Solheim et al. (2012) did not report any differences between the HA users and disusers for environmental influence. Solheim et al. (2012) did not address possible reasons as to why their study did not find an association with environmental influence and HA use. Similarly, Wilson and Stephens (2003) also found no effects of environmental influence on HA use. However, it was found that the majority of participants in their study that were referred for HAs, were motivated by others. However the motivating factor (self or other) did not appear to affect later HA use. Therefore it is possible that environmental influences are more important in the early stages of HA rehabilitation but not the later stages. As a result, those who are motivated purely by others maybe more likely to become a HA disuser. As mentioned previously, an individual's accepted need is likely to influence HA use, and if others have encouraged an individual to try HAs when they do not believe they need them, they may stop using them, becoming a HA disuser.

4.3.1.2 Follow-up support

HA users also reported receiving more follow up support after HA fittings than disusers, thus supporting part (b) of hypothesis. This is again in agreement with findings by Solheim et al. (2012) who found that participants who received more

follow up support were more likely to use their HAs. Vourialho et al. (2006) also reported that regular follow up support decreased the number of HA disusers and increased the number of occasional users to regular users. These findings are also consistent with Eriksson-Mangold et al. (1990) who conducted a study on fitting programmes on an experimental group and a control group. Like this study, it was found that there was a significantly higher use of HAs in individuals who had received more follow-up support. Therefore follow-up support is likely to lead to an increase in HA use and a decrease in disuse. Self-efficacy may even be enhanced as follow-up support can significantly increase an individual's handling skills with their HAs. Furthermore, follow-up support allows an audiologist to address individuals' issues before they start disusing their HAs. For example, a commonly cited reason for HA disuse is that an individual's aid is "too noisy". A HA maybe considered "too noisy" when there is internal noise or if the maximum power output (MPO) is set too loud or when the HA is used in high-level background noise. These reasons for not wearing HAs would be relatively straightforward to deal with, either by a quick HA adjustment and/or counselling of expectations after HA fittings.

4.3.2 Non-significant Variables

All environmental factors were found to differentiate HA users from disusers.

4.4 Relationship Between Hearing Aid Disuse and Activity Limitations and Participation Restrictions (AL/PR)

Hypothesis 4 stated that there would be significant differences between the HA use and disuse group for hearing related AL/PR. This study found that scores on

the HHQ were significantly different between the groups, thus supporting this hypothesis.

4.4.1 Significant Variables

4.4.1.1 Activity limitations/Participation restrictions (AL/PR)

Scores on the HHQ differentiated HA users from disusers, thus supporting part a of the hypothesis. In this study, HA users exhibited significantly more hearing related AL/PR than HA disusers. This finding supports data from overseas studies that has also shown a positive relationship between self-perceived AL/PR and HA use (Cox et al., 2007; Hickson et al., 2014; Hosford-Dunn & Halpern, 2001). These results also support Takahashi et al.'s (2007) theory that individuals who perceive themselves as experiencing AL/PR as a result of a hearing impairment are more likely to recognize the benefits of HAs. It is therefore possible that not perceiving AL/PR related to a hearing impairment may contribute to HA disuse. Therefore self-reported AL/PR maybe a better choice than measuring hearing sensitivity when determining if an individual will use their HAs.

4.4.2 Non-significant Variables

The HHQ was found to differentiate HA users from disusers.

4. 6 Significant Variables Discriminating Hearing Aid Users From Disusers

Discriminant analysis was used to determine the best predictors for HA disuse. In this study, the most important predictive factors were: HA outcomes, perceived environmental influence on their experience of hearing impairment, ability to understand speech in noise, and perceived hearing related AL/PR. As mentioned previously, those who perceive themselves as experiencing more AL/PR as a result of their hearing impairment may be more likely to recognize the benefits of using HAs. An individual with a hearing impairment who does not perceive these hearing related AL/PR may not see the full benefits of using HAs. Instead these individuals may be motivated by others to try HAs. This may result in their HAs only being used short-term, as it is likely that an individual needs to be self-motivated to use their HAs long-term. Conversely, if an individual is self-motivated and observes a change in their hearing related AL/PR from using HAs, it is likely that they will report better HA outcomes and use their HAs.

Interestingly, no demographic variables were found to be significant discriminating variables. Therefore self-reported AL/PR, environmental influence and the ability to understand speech in noise maybe a better way of determining if an individual will use their HAs than enquiring about other personal factors and measuring hearing sensitivity.

4.7 Clinical Implications

One of the primary aims of this study was to add to the small amount of research on HA disuse, particularly in Aotearoa/New Zealand. This examination of HA use has led to some interesting outcomes that have implications on the clinical practice of audiology. While there is need for further research about HA disuse, the results of this study suggest there is clinical value in utilizing HRQoL instruments (such as the HHQ), outcome measures (such as the IOI-HA), experience with HA measures (HAQ) as well as an audiometric test for the ability to understand speech in noise (such as the QuickSIN) in the clinical setting. Use of such tools may assist the audiologist to better serve the client in ways that are beneficial and meaningful, and to make more informed decisions that lead to greater HA use.

For example, the results of this study show that perceived hearing related AL/PR is a significant factor discriminating HA use from disuse. Recognising the presence and importance of this variable, via the use of quality of life surveys can help the audiologist make better client-focused decisions; particularly as the effects of hearing impairment will vary from adult to adult. The primary mechanism for addressing deficits of participation and quality of life is counselling. This can be achieved through sensory management, instruction and perception training. Counselling allows an individual to discuss and come to terms with the impact of their hearing impairment on their everyday life, discuss their feelings and explore ways to address the social, practical and emotional consequences of hearing impairment.

For this sample, individuals who reported more follow-up support were more likely to be HA users. Therefore counselling and follow-up support should be an important consideration for audiologists, particularly when encouraging first-time HA users to use their HAs regularly. Thus, it is important that audiologists take the time to address the emotional aspects of hearing impairment as well as educate and support their clients.

With regards to audiometric variables, SNR loss was found to be an important variable in discriminating HA users from disusers. The more difficulty individuals had understanding speech in the presence of background noise, the more likely they were to be HA users. Therefore a test of speech understanding can provide the clinician with information not uncovered through other audiometric tests. For example, pure-tone audiometry does reveal information about the softest sound an individual can detect in a quiet setting, however this is not particularly representative of everyday life. A speech in noise test is not completely realistic about communication environments but it does provide information about an individual's experience with their hearing impairment, which can assist with awareness of their difficulties and help with counselling and rehabilitative options for the individual. For example, if an individual is found to have a moderate SNR loss on the QuickSIN, the audiologist should utilize directional microphones. Individuals identified with severe SNR loss should be encouraged to try FM systems and communication strategies. Future research into the relationship between SNR loss and use of HAs would be clinically useful.

4.8 Limitations and Directions for Future Use

This study has several limitations. Mentioned previously, there was a lack of demographic diversity that made up the study population. This was a particular problem when looking at ethnicity and gender. Furthermore, there may be little generalizability of the study results into the larger population of hearing impaired adults in New Zealand, as only adults in the Canterbury region were invited to participate in this study. Therefore future studies should employ targeted recruitment to ensure that there is a more diverse study population from around the country.

Another limitation of this study is that HA disusers relied on delayed recall to report on their past experiences with HAs. As a result, it could have been months, years or decades since participants had worn HAs, which may have impacted on the accuracy of their responses. Furthermore, this population was a heterogeneous group, as this study did not control for the time period of HA disuse. Therefore future studies should control for this by conducting a prospective longitudinal study where participants are recruited from HA fitting and followed for five or more years.

A further limitation of this study is that the URICA questionnaire utilized was a modified version by Laplante-Lévesque et al. (2013) and did not include the maintenance stage. Future studies should look at modifying the original 32-item questionnaire to include the maintenance stage. Future studies should also look at including an “other” option on the demographic questionnaire, so disusers can report reasons for disuse that are not addressed in any of the other questionnaires, as this appeared to be a useful feature of questionnaires from overseas studies. Furthermore, future studies should include the MARS-HA (Measure of Audiologic Rehabilitation

Self-efficacy for HAs) in the data packet, as it would provide detailed insight into participants' HA self-efficacy.

4.9 Conclusion

The present study aimed to identify factors associated with HA disuse in New Zealand. As a clinician it is important to understand why individuals do not their use HAs after obtaining them. This study has found that body functions, personal factors, environmental factors and hearing related AL/PR influence HA use/disuse in New Zealand/Aotearoa. The results of this study further suggest that clinicians can gain valuable information by employing a speech in noise test and by including self-report questionnaires such as the IOI-HA and the HHQ. The clinical value of using these measures is to identify factors related to hearing disuse, so clinicians can identify the “red flags” for disuse before the client stops using their HAs. By identifying these red flags, clinicians can tailor rehabilitation around the individual's needs, to ensure that a client does not experience the negative consequences of an untreated hearing impairment.

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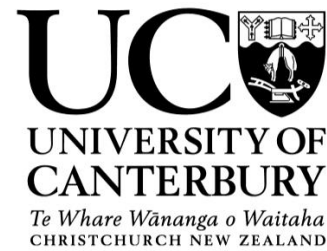
Appendix A

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Information Sheet

Factors associated with hearing aid disuse in Aotearoa/New Zealand.

I am a Master of Audiology student investigating the factors associated with hearing aid disuse in New Zealand. It is estimated that only 28% of adults who report a significant hearing impairment also report owning hearing aids. A percentage of these owners do not use these hearing aids. To date there has been no study that investigates the reasons for hearing aid disuse in the New Zealand population. The outcomes of this study can help highlight reasons for disuse and may clarify potential barriers for use. Identifying these variables may also help clinicians provide better and more appropriate interventions for adults who choose to discontinue use of their hearing aids.

Your involvement in this project will be to complete the forms in your data packet. These forms are: 1) a copy of the information and informed consent sheets; 2) a demographic questionnaire; 3) Hearing Handicap Questionnaire; 4) Self-Efficacy Situational Communication Management Questionnaire and 5) International Outcomes Inventory for Hearing Aids. At the data collection session you will be required to: 1) bring the data packet; 2) undergo a hearing test; 3) undergo a QuickSIN test; 4) perform the ANL test; 5) perform the Purdue pegboard test and 6) and discuss your experiences with your hearing aids. It is estimated that the data collection session will take between 60-90minutes.

You may receive a copy of the project results by contacting the researcher at the conclusion of the project.

Participation is voluntary and you have the right to withdraw at any stage without penalty. If you withdraw, I will remove all information relating to you.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: your identity will not be made public without your prior consent. To ensure anonymity and confidentiality, your name will not be used during data analysis; instead, participant identification numbers will be used. All data will also be stored in a locked room and electronic copies will be password protected. This data will be destroyed after a five-year period. A thesis is a public document and will be available through the UC Library.

This project is being carried out as a requirement for a Master of Audiology by Louise Allan under the supervision of Dr Rebecca Kelly-Campbell who can be

contacted at rebecca.kelly@canterbury.ac.nz. or by phone on 03 364 2987 extension 8327. She will be pleased to discuss any concerns you may have about participation in the project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

If you agree to participate in the study, you are asked to complete the consent form and return it to the researcher.

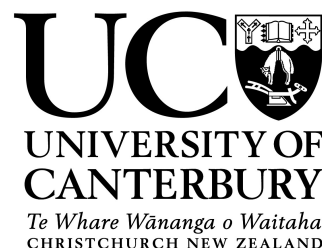
Appendix B

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Consent Form

Factors associated with hearing aid disuse in Aotearoa/New Zealand.

I have been given a full explanation of this project and have had the opportunity to ask questions.

I understand what is required of me if I agree to take part in the research.

I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided.

I understand that any information or opinions I provide will be kept confidential to the researcher and the researchers supervisor and that any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the UC Library.

I understand that all data collected for the study will be kept in locked and secure facilities and in password protected electronic forms will be destroyed after five years.

I understand the risks associated with taking part and how they will be managed.

I understand that I am able to receive a report of the findings of the study by contacting the researcher at the conclusion of the project.

I understand that I can contact the researcher Louise Allan (lma116@uclive.ac.nz) or supervisor Dr Rebecca Kelly-Campbell who can be contacted at rebecca.kelly@canterbury.ac.nz or by phone on 03 364 2987 extension 8327 for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Please tick the box if you would like to:

☐ Receive a copy of the transcribed interview.

Email or postal address: _____

☐ Receive a copy of the final report.

Email or postal address: _____

By signing below, I agree to participate in this research project.
Please return this form to the researcher at the data collection session.

Signature: _____

Date: _____

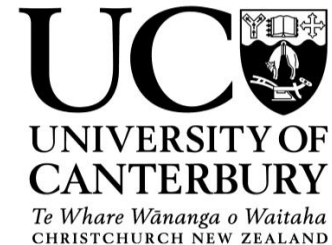
Appendix C

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PARTICIPANT INFORMATION

Please answer every question honestly and to the best of your ability.

ID: _____ Date: _____

Current age: _____ Gender: _____

Ethnicity/culture: _____

1. On a scale of 1 to 10, how would you describe the severity of your hearing problem (1 = not at all severe, 10 = very severe)? _____
2. Have you ever worn hearing aids (if no, go to question 3)? _____
 - a. Do you wear hearing aids in one ear or both ears? _____
 - b. At what age did you start wearing them? _____
 - c. How many hours a day do you wear your hearing aids? _____
 - d. In what situations do you wear your hearing aids? _____
 - e. On a scale of 1 to 10, how would you rate your level of satisfaction with them (1 = not at all satisfied, 10 = very satisfied)? _____

P.T.O

3. Have you ever used other kinds of technology to help you hear or communicate (if no, go to question 4)? _____

a. What type of technology do you use (please tick all that you use)?

☐ amplified phone

☐ closed caption on TV

☐ FM system

☐ Loop system

☐ something else (please list) _____

b. How often do you use this kind of technology? _____

c. On a scale of 1 to 10, how would you rate your level of satisfaction with this kind of technology (1 = not at all satisfied, 10 = very satisfied)? _____

4. What is the highest level of education you completed (please tick only one box)?

☐ some primary school

☐ completed primary school

☐ completed high school

☐ completed an undergraduate diploma or certificate

☐ completed an undergraduate degree

☐ completed a postgraduate degree or certificate at a university

5. Are you currently working outside of the home? _____

a. If so, what is your occupation?

P.T.O

6. What is the annual net income in your household? (please tick one box)

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
\$0 - \$30,000	\$30,000-\$60,000	\$60,000-\$90,000	\$90,000-\$120,000	>\$120,000

7. Have you ever applied for a hearing aid government subsidy? _____

8. Have you been eligible for any other hearing aid funding? _____

a. If so, please list the other funding sources

9. What is your relationship status? (please tick one box)

- ☐ not in a relationship
- ☐ widowed
- ☐ in a relationship but do NOT live with a partner
- ☐ live with a partner
- ☐ married/in a defacto partnership

10. How many adults live in your home? _____

11. How many children live in your home? _____

P.T.O

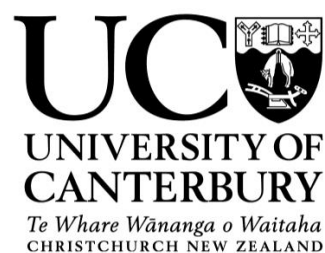
Appendix D

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HEARING HANDICAP QUESTIONNAIRE (HHQ)

ID:

Date:

PARTICIPANT INFORMATION

Please TICK the box that best answers the following questions.

1. How often does your hearing difficulty restrict the things you do?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

2. How often do you feel worried or anxious because of your hearing difficulty?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

3. As a result of your hearing difficulty, how often do you feel embarrassment when in the company of other people?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

4. How often is your self-confidence affected by your hearing difficulty?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

5. How often does your hearing difficulty make you feel nervous or uncomfortable?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

6. How often does any difficulty with your hearing make you feel self-conscious?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

7. How often does your difficulty with your hearing affect the way you feel about yourself?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

8. How often are you inconvenienced by your hearing difficulty?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

9. How often do you feel inclined to avoid social situations because of your hearing difficulty?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

10. How often do you feel cut off from things because of your hearing difficulty?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

11. How often does your hearing difficulty restrict your social or personal life?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

12. How often do you feel tense and tired because of your hearing difficulty?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Almost always

P.T.O

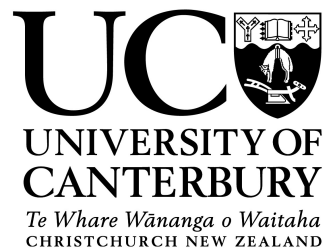
Appendix E

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INTERNATIONAL OUTCOME INVENTORY – HEARING AIDS (IOI-HA)

ID:

Date:

PARTICIPANT INFORMATION

Please TICK the box that best answers the following questions.

1. Think about how much you used your present hearing aid(s) over the past two weeks. On an average day, how many hours did you use the hearing aid(s)?

- | | | | | |
|--------------------------|---------------------------|--------------------------|--------------------------|----------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| none | less than 1
hour a day | 1 to 4
hours a day | 4 to 8
hours a day | more than 8
hours a day |

2. Think about the situation where you most wanted to hear better, before you got your present hearing aid(s). Over the past two weeks, how much has the hearing aid helped in that situation?

- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| helped
not at all | helped
slightly | helped
moderately | helped
quite a lot | helped
very much |

3. Think again about the situation where you most wanted to hear better. When you use your present hearing aid(s), how much difficulty do you STILL have in that situation?

- | | | | | |
|--------------------------|------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| very much
difficulty | quite a lot of
difficulty | moderate
difficulty | slight
difficulty | no
difficulty |

4. Considering everything, do you think your present hearing aid(s) is worth the trouble?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
not at all worth it	slightly worth it	moderately worth it	quite a lot worth it	very much worth it

5. Over the past two weeks, with your present hearing aid(s), how much have your hearing difficulties affected the things you can do?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
affected very much	affected quite a lot	affected moderately	affected slightly	affected not at all

6. Over the past two weeks, with your present hearing aid(s), how much do you think other people were bothered by your hearing difficulties?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bothered very much	bothered quite a lot	bothered moderately	bothered slightly	bothered not at all

7. Considering everything, how much has your present hearing aid(s) changed your enjoyment of life?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
worse	no change	slightly better	quite a lot better	very much better

P.T.O

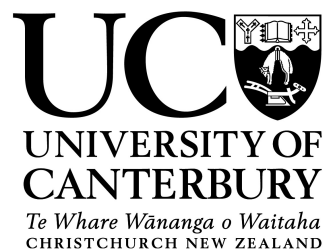
Appendix F

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HEARING AID QUESTIONNAIRE

ID:

Date:

PARTICIPANT INFORMATION

Please CIRCLE the number that best answers the following questions.

0 means you completely agree with the statement and 10 means you completely disagree statement.

1. I need to use my hearing aid every day

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

2. I benefit from my hearing aid

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

3. My hearing aid is a part of me, i.e. I have accepted that I need it

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

4. My aim has been to use my hearing aid the whole day, even when I'm by myself

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

5. My hearing aid has made it easier for me to communicate with other people.

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

6. I have adapted to my hearing loss emotionally

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

7. I got used to my hearing aid relatively quickly

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

8. I have shared my experiences about using a hearing aid with other people

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

9. I had enough time for education, training and questions at the hearing aid clinic

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

10. It was easy to get in touch with the hearing aid clinic when I needed help

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

11. I was followed up with regard to using and operating my hearing aid

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

P.T.O

12. My hearing aid has been relatively easy to operate

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

13. My expectations about getting a hearing aid have been fulfilled/met

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

14. It has not been socially embarrassing for me to use a hearing aid among other people

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

15. My impression is that hearing impaired of my age are satisfied with their hearing aids

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

16. Pressure from relatives is the main reason for providing hearing aids

0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

17. I am well informed about the cause of my hearing loss

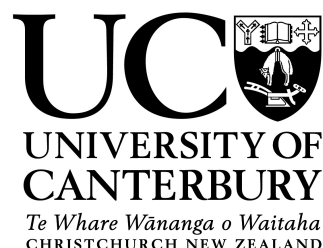
0	1	2	3	4	5	6	7	8	9	10
completely agree										completely disagree

P.T.O

Appendix G

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Self-efficacy for Situational Management Questionnaire (SESMQ)

Date:

PARTICIPANT INFORMATION

We are interested in **how well you believe that you can hear** and **how confident you are that you can manage communication** in the following 20 situations today when wearing your hearing aid or another assistive listening device.

Please read each of the following situations.

For each situation, please rate **how well you believe that you can hear and how confident you are that you can manage communication** by circling the number that best applies to you.

Sample Situation & Rating:

You are on the bus and a stranger talks to you with one hand over her/his mouth.

How well can you hear in this situation?

0	1	2	3	4	5	6	7	8	9	10
Not well at all				Moderately well						Very well

How confident are you that you can manage this situation?

0	1	2	3	4	5	6	7	8	9	10
Not confident at all			Moderately confident					Very confident		

1. You are having a conversation with a friend or family member in your home. The room is dark because the curtains are partially closed and the light is off.

How well can you hear in this situation?

0	1	2	3	4	5	6	7	8	9	10
Not well at all					Moderately well					Very well

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

2. Your friend/family member is trying to talk to you when she/he is in another room.

How well can you hear in this situation?

0 1 2 3 4 5 6 7 8 9 10
Not well at all Moderately well Very well

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

3. You are at a party where the conversation is noisy. Someone who you have never met before comes over to speak to you.

How well can you hear in this situation?

0 1 2 3 4 5 6 7 8 9 10
Not well at all Moderately well Very well

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

4. You are at the doctor's office. The receptionist calls you from across the room to let you know that it is your turn to see the doctor.

How well can you hear in this situation?

0 1 2 3 4 5 6 7 8 9 10
Not well at all Moderately well Very well

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

P.T.O

5. You are watching television at home. The actors speak amid the background music.

How well can you hear in this situation?

0 1 2 3 4 5 6 7 8 9 10
Not well at all Moderately well Very well

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

6. You hold a card party in your home. You are seated at a table with people you do not know very well.

How well can you hear in this situation?

0 1 2 3 4 5 6 7 8 9 10
Not well at all Moderately well Very well

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

7. You are at home watching television with a family member. She/he turns and speaks to you.

How well can you hear in this situation?

0 1 2 3 4 5 6 7 8 9 10
Not well at all Moderately well Very well

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

8. You are going to a public lecture. There are no seats available near the speaker. How well can you hear in this situation?

0 1 2 3 4 5 6 7 8 9 10
Not well at all Moderately well Very well

P.T.O

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

9. You are waiting for a train/plane at a busy station. Your friend is sitting beside you and says something without looking at you.

How well can you hear in this situation?

0 1 2 3 4 5 6 7 8 9 10
Not well at all Moderately well Very well

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

10. You hold a party in your home. Someone you do not know very well starts up a conversation. She/he puts one hand over her/his mouth when they are speaking.

How well can you hear in this situation?

0 1 2 3 4 5 6 7 8 9 10
Not well at all Moderately well Very well

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

11. You are having a family dinner in your home. There is more than one conversation occurring at a time.

How well can you hear in this situation?

0 1 2 3 4 5 6 7 8 9 10
Not well at all Moderately well Very well

How confident are you that you can manage this situation?

0 1 2 3 4 5 6 7 8 9 10
Not confident at all Moderately confident Very confident

P.T.O

12. You are at a wedding reception with 200 guests. Your friend/family member starts talking to you.

How well can you hear in this situation?

0	1	2	3	4	5	6	7	8	9	10
Not well at all				Moderately well				Very well		

How confident are you that you can manage this situation?

0	1	2	3	4	5	6	7	8	9	10
Not confident at all				Moderately confident				Very confident		

13. You are in a restaurant with a family member or friend. You are seated in a dim and noisy spot.

How well can you hear in this situation?

0	1	2	3	4	5	6	7	8	9	10
Not well at all				Moderately well				Very well		

How confident are you that you can manage this situation?

0	1	2	3	4	5	6	7	8	9	10
Not confident at all				Moderately confident				Very confident		

14. You telephone a family member/friend using a pay phone. There is a lot of noise from people passing behind you.

How well can you hear in this situation?

0	1	2	3	4	5	6	7	8	9	10
Not well at all				Moderately well				Very well		

How confident are you that you can manage this situation?

0	1	2	3	4	5	6	7	8	9	10
Not confident at all				Moderately confident				Very confident		

P.T.O

15. You are at home. The telephone rings. You do not recognize the caller's voice and cannot understand what she/he is saying.

How well can you hear in this situation?

0	1	2	3	4	5	6	7	8	9	10
Not well at all				Moderately well				Very well		

How confident are you that you can manage this situation?

0	1	2	3	4	5	6	7	8	9	10
Not confident at all				Moderately confident				Very confident		

16. You answer the door. The postal carrier hands you a package and asks you a question.

How well can you hear in this situation?

0	1	2	3	4	5	6	7	8	9	10
Not well at all				Moderately well				Very well		

How confident are you that you can manage this situation?

0	1	2	3	4	5	6	7	8	9	10
Not confident at all				Moderately confident				Very confident		

17. You attend a meeting with 3 other persons. You have attended this meeting on a regular basis.

How well can you hear in this situation?

0	1	2	3	4	5	6	7	8	9	10
Not well at all				Moderately well				Very well		

How confident are you that you can manage this situation?

0	1	2	3	4	5	6	7	8	9	10
Not confident at all				Moderately confident				Very confident		

P.T.O

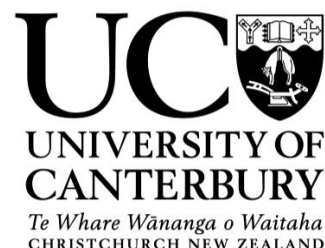
Appendix H

Department of Communication Disorders

College of Science

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www.cmds.canterbury.ac.nz



University of Rhode Island Change Assessment (URICA) – modified

Participant ID:

Date:

PARTICIPANT INFORMATION

Please TICK the box that best answers the following questions.

1. As far as I'm concerned, I don't have any problems with my hearing that need changing.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

2. I think I might be ready for some self-improvement for my hearing.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

3. I am doing something about the problems with my hearing that had been bothering me.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

4. It might be worthwhile to work on my problem with my hearing.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

P.T.O

5. I'm not the problem one. It doesn't make much sense for me to be here.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

6. I am finally doing some work on my problem with my hearing.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

7. I've been thinking that I might want to changing something about myself.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

8. At times my problem with my hearing is difficult, but I'm working on it.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

9. Being here is pretty much a waste of time for me because the problem doesn't have to do with me.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

10. I'm hoping this place will help me to better understand myself.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

11. I guess I have faults, but there's nothing that I really need to change.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

P.T.O

12. I am really working hard to change.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

13. I have a hearing problem and I really think I should work at it.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

14. Even though I'm not always successful in changing, I am at least working on my problem with my hearing.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

15. I wish I had more ideas on how to solve the problem with my hearing.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

16. I have started working on my problems with my hearing but I would like help.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

17. Maybe this place will be able to help me.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

18. I may be part of the problem with my hearing, but I don't really think I am.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

P.T.O

19. I hope that someone here will have some good advice for me.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

20. Anyone can talk about changing; I'm actually doing something about it.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

21. All this talk about psychology is boring. Why can't people just forget about their problems with their hearing?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

22. I have worries but everybody does. Why spend time thinking about them?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

23. I am actively working on my problem with my hearing.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

24. I would rather cope with my faults than try to change them.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strongly disagree	Disagree	Undecided	Agree	Strongly agree

Appendix I



HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2014/27

23 May 2014

Louise Allan
Department of Communication Disorders
UNIVERSITY OF CANTERBURY

Dear Louise

The Human Ethics Committee advises that your research proposal "Factors associated with hearing aid use in Aotearoa/New Zealand" has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 16 May 2014.

Best wishes for your project.

Yours sincerely

A handwritten signature in black ink, appearing to read 'L. MacDonald'.

Lindsey MacDonald
Chair
University of Canterbury Human Ethics Committee